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The Effects of Video Modeling and a Lag Schedule of Reinforcement on Toy Play Behaviors of Children with Autism

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The Effects of Video Modeling and a Lag Schedule of Reinforcement on Toy Play Behaviors of Children with Autism

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Dedication

I dedicate this dissertation work to my parents and to the children who have graciously allowed me to be a part of their lives, especially to my “tiny” angel.

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The Effects of Video Modeling and a Lag Schedule of Reinforcement on Toy Play Skills of Children with Autism

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Video modeling is a research-based intervention used to teach play skills to children with autism. While children learned to imitate the play behaviors seen in the videos, increases in play behaviors that differed from the videos were not evident. The current study examined the use of video modeling and video modeling with an added lag schedule of reinforcement, on increasing toy play of five children with autism in their homes. During video modeling, the children watched a short video portraying a person playing with toy figurines. Then, they were given the toys and instructed to play independently for 5-min. During the video model with lag schedule reinforcement, praise and preferred snacks were provided when his or her toy play was different from immediately preceding responses during the play session. A nonconcurrent multiple baseline across participants design was used to examine the effects. Overall results indicated that the children learned scripted toy play and increased in levels of varied play, but did not increase significantly *nor* decrease in levels of unscripted toy play from baseline. Even with the additional reinforcement, the children's play did not increase in levels of varied play, scripted or unscripted play behaviors for four of five participants. Social validity of the child's play outcomes and the perceived ease of use of the intervention were assessed using questionnaires filled out by parents and behavioral therapists. Discussion, limitations, and implications for future research are presented.

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Chapter 1: Introduction

It is universally recognized that play is an essential activity to the well-being and development of children. This view is so paramount that the United Nations convention on the Rights of a Child, Article 31 states, “That every child has the right to rest and leisure, to engage in play and recreational activities appropriate to the age of the child...” Although there is no exact definition of play, researchers agree that it is an activity that is complex, flexible, fun, spontaneous and child-led (Luckett, Bundy & Roberts, 2007; Mastrangelo, 2009). There is also a general consensus amongst researchers that play serves a substantial role in the development of children’s cognitive, social and emotional regulation (Ginsburg, 2007; Myck-Wayne, 2010). Play activities allow children to explore and interact with the surrounding world, a process important to the development of creativity, cognition, social skills, and emotional regulation (Frost, Wortham & Reifel, 2005; Myck-Wayne, 2010). In many ways, child’s play is the medium through which a child develops the competencies that become the foundation for handling future experiences and challenges. The benefits of play are not exempt for children with disabilities. Barton and Wolery (2008) describe play as a flexible activity that can be used in multiple settings, provide opportunities for social and communicative interactions with peers, increase the likelihood of learning in natural settings and a context in which communicative, social and cognitive goals may be embedded. Therefore, play is an important activity for all children to engage in (Frost et al., 2005; Myck-Wayne, 2010; NAEYC, 1997).

Children with autism, however, often do not exhibit appropriate play development. In fact, one of the diagnostic characteristics of autism is a profound lack of varied, imaginative or symbolic play (American Psychiatric Association, 1994). Additionally, play behaviors that do develop may be inappropriate (e.g., repetitive or rote). These challenges are often pervasive without intervention (Baron-Cohen, 1987; Wulff, 1985). A child with autism, for example, may have only a handful of pretend play behaviors when playing with others. They may also be unable or unwilling to develop or expand their current play along a thematic storyline. This type of inflexible or rote play, when playing with other children, can be very isolating for children with ASDs (Jarrold, 2003). Therefore, early intervention goals are often filled with teaching play skills for this population (Myck-Wayne, 2010).

There are a number of interventions that improve play behaviors such as pivotal response training (PRT), reciprocal imitation training, differential reinforcement, in vivo modeling, play scripts, video modeling and mileu training (Stahmer, Ingersoll & Carter, 2003; Terpstra, Higgins & Pierce, 2002; Lang et al., 2009). Video modeling, a well-validated intervention, has been used to teach a variety of adaptive behaviors, including play (McCoy & Hermansen, 2007; Shukla-Mehta, Miller & Callahan, 2010). It is a convenient, nonintrusive intervention strategy that involves the individual viewing a video and then imitating the actions in the video (Banda, Matuszny, & Turkan, 2007). Despite overall positive outcomes for improving play, a major criticism of video modeling and other behavioral methods is that these structured methods teach the child how to “go through the motions” of playing, resulting in play that lacks spontaneity and creative zeal (Boutot, Guenther & Crozier, 2005; Luckett et al., 2007). Recent reviews on play interventions (Luckett et al., 2007; Lang et al., 2009) cite a need for measuring other dimensions of play that better describe the qualities of play outcomes. In other words, researchers should begin to look at dependent measures that reflect the truer definition of play. Two variables with limited research in play include improving generalization (e.g., response generalization) and variability of play actions.

Although often seen in the form of play or stereotypical behaviors, a prominent characteristic of autism is the tendency towards repetitive responding (or lack of varied/novel responding). For example, individuals with autism may engage in simple or repeated patterns of responding and/or less likely to try alternative available options compared to children without disabilities. Mullins and Rincover (1985) found that when given five options of various schedules of reinforcement (e.g., continuous reinforcement and various fixed ratio schedules), individuals without disabilities sampled all five possibilities and chose the option that maximized reinforcement. However, individuals with autism sampled significantly less options than individuals without disabilities. For some of these individuals, failure to sample all options actually led to missed opportunities for reinforcement. Additionally, the ability to diversify responding is related to creativity and problem solving (Neuringer, 2004), characteristics paramount to the descriptions of play. Given the inherent tendency for lessened variability and overall deficits in play, play interventions to increase response diversity are needed for individuals with ASDs.

Current basic and applied research on variability suggests that it may be an operant dimension of behavior (Carr & Kologinsky, 1983, Duker & van Lent, 1991; Goetz & Baer, 1973; Lalli, Zanolli & Wohn, 1994; Pryor et al., 1983). In other words, consequences in the environment can bias responding towards increased variability. Pryor, Haag & O'Reilly (1969) provided one of the earliest demonstrations of increasing variability through reinforcement methods. They demonstrated that porpoises could be trained to produce novel behaviors using the contingency that only novel actions (actions not previously reinforced) were targeted for reinforcement. Goetz & Baer (1973) provided an example of increasing variability in toy block play using reinforcement contingencies. A variant of a single subject reversal design compared the effects of reinforcing novel block formations to reinforcing repetitive block forms or forms previously expressed by three preschool aged children. New formations were produced when only novel formations were reinforced. Lalli, Zanolli, and Wohn (1994) placed play behaviors on extinction and reinforced behaviors that were different from previous behaviors, resulting in an increase in novel toy play behaviors. Napolitano, Smith, Zarcone, Goodkin, and McAdam (2010) demonstrated that a lag schedule could be used to reinforce diversity of block building rather than only novel responding. Similar to reinforcing novel responses, lag schedules also rely on previous responses to determine whether the current response is reinforced. The investigators used a lag 1 schedule in which the most current response was reinforced only if it was different from the preceding response. In other words, lag schedules reinforce the dimension of variability within a set of behaviors. Repeated responses could be reinforced again as long as they were separated by other responses (depending on the lag requirement). This type of reinforcement schedule may be more appropriate to use with individuals who are less likely to emit completely novel responses independently. Although increases in varied actions do not necessarily equate to increases in novel behaviors, the results of previous research indicate that lag schedules may be associated with increased production of novel behaviors (Lee, McComas & Jawor, 2002).

Given the success of video modeling interventions and the continued need to explore more qualititative characteristics of play, this study will describe the effects of combining two intervention components (video modeling and lag schedules) on varied play behaviors, scripted actions and unscripted actions.

Research questions

The following research questions will be addressed in this project:

1. What are the effects of video modeling on variability of play behaviors?
2. What are the effects of video modeling on unscripted play?
3. What are the effects of video modeling with a lag schedule of reinforcement on variability of play?
4. What are the effects of video modeling with a lag schedule of reinforcement on unscripted play?

Chapter 2: Literature review of video modeling interventions to increase play skills for children with autism spectrum disorders

Although there is no exact definition of play, experts agree that it is a complex, internally motivated activity characterized as spontaneous, flexible and creative in nature (Mastrangelo, 2009). Play is an important activity for young children to engage in because it is linked to social, cognitive, physical and emotional development. It also provides the context in which children explore and learn how to interact with the surrounding environment (Ginsburg, 2007). For example, children may be introduced to skills such as perspective taking or emotional regulation that are foundational to developing relationships with peers (Frost, Wortham & Reifel, 2005; Ginsburg, 2007). However, children with autism spectrum disorders (ASDs) often do not develop appropriate play behaviors. In fact, one of the diagnostic characteristics of autism is a profound absence of varied, imaginative or symbolic play (American Psychiatric Association, 1994). These children may engage in play that is rote or fails to be developmentally appropriate such as repetitive or stereotypic nonfunctional play (Baron-Cohen, 1987; Wulff, 1985). Additionally, global difficulties in imitation, expressive, and receptive communication skills often complicate the development of appropriate play. These challenges are often pervasive without intervention.

Given the clear need to target play skills with the ASD population, there are a number of behavioral interventions that have been developed. These include pivotal response training, reciprocal imitation training, differential reinforcement, in vivo modeling, play scripts, video modeling and milieu training (Stahmer, Ingersoll & Carter, 2003; Terpstra, Higgins & Pierce, 2002; Lang et al., 2009). Video modeling, in particular, is a popular intervention used with individuals with ASDs to teach a variety of new skills. During video modeling, the individual watches a video of a person (or persons) modeling the desirable behaviors and then is asked to imitate the video (Banda, Matuszny, & Turkan, 2007; McCoy & Hermansen, 2007). Various literature reviews have been conducted on the use of video modeling interventions with individuals with autism or other developmental disabilities (Rayner, Denholm, & Sigafoos, 2009; McCoy & Hermansen, 2007; Shukla-Mehta et al., 2010). For example, McCoy and Hermansen (2007) reviewed the impact of the type of model used in the video (e.g., peer, adult or a mix of the two) on the effectiveness of acquisition of behaviors targeted through video modeling. Shukla-Mehta, Miller and Callahan (2010) reviewed the effects of various video types such as video modeling, video self modeling and point of view video modeling on social and communication skills training. Collectively, these reviews indicate that video modeling is an effective, versatile intervention for individuals with ASDs. However, a literature review on video modeling as an intervention to improve play skills for this population has not yet been published.

The primary purpose of this chapter is to identify, review, and summarize research on video modeling interventions used to improve play related behaviors for children with ASDs. Reporting this information serves to extend the literature base by providing a more comprehensive view of video modeling as an intervention, identify the common characteristics of the studies and general effectiveness specifically for play outcomes.

METHOD

Search

An electronic database search was conducted using three databases: PsycINFO, Psychology and Behavioral Sciences Collection and Education Resource Information Center (ERIC). The terms *video model*(or video based or video instruction)* were entered in the first search field, *play (or leisure or toys or pretend or recreation)* entered in the second field and *autism (or autistic)* entered in the third search field. The search was limited to entries published in the English language and in peer-reviewed journals. After duplicates were removed, there were 52 total entries. Inclusion criteria were applied in order to determine which articles would be included or excluded in the review.

Inclusion-exclusion Criteria

To be included, the study must have met all of the following criteria:

(a) The study included at least one participant with an autism spectrum disorder (ASD) up to and including 8 years of age.

(b) The intervention involved a video-modeling component. Video modeling was defined as a process in which the participant observed a video of a model engaging in a target behavior and then was expected to imitate the behavior.

(c) At least one dependent variable measured play. The use of a play context to teach other skills was not enough for a study to be included. For example, some researchers measured social initiations (Kroeger, Schultz, & Newsome, 2007) or used toys as props for conversational speech (Charlop & Milstein, 1989; Charlop, Dennis, Carpenter, & Greenberg, 2010; Gena, Couloura, Kymissis, 2005) but did also measure play behaviors.

(d) The researchers utilized a research design and methodology that allowed for the evaluation of the intervention on the participants' behaviors. Examples included single-case research designs, group designs with a control (citation).

Nineteen studies met the inclusion criteria. These 19 studies included a total of 44 participants. Table 1 provides a summary of each included study.

Coding and Summary of Studies

The 19 studies were coded using a computerized data sheet specifically designed for this review. Each article was read and pertinent information extracted and recorded on the data sheet.

Each study was classified into one of two possible categories based on the type of play demonstrated in the video model intervention: solitary play or social play. Studies were categorized as solitary play if the video showed one person playing or focused on increasing play behaviors of the participant playing alone. Studies were categorized as social play if the video depicted two or more people playing or focused on increasing play behaviors of the participant with one or more people. Once categorized, each study was summarized according to the following features (see Table 1): (a) participant characteristics (e.g., sex, diagnosis, age); (b) targeted skills (dependent variables); (c) intervention components; (d) outcomes. Acquisition and generalization outcomes were reported as described by authors.

Table 1: Summary of reviewed studies.

Study citation	Participants	Dependent variables	Intervention components	Outcomes
Solitary play				
Boudreau & D'Entremont (2010)	2 boys , PDD-NOS[1]; 2 years, 8 months and 2 years, 10 months	Play actions and verbalizations (scripted and unscripted)	• VM[2]: scripted play with veterinary and construction sets • Sessions were conducted across phases: VM only, VM plus reinforcement, and reinforcement without any videos	*Results:* Both participants increased scripted play actions and verbalizations but decreased unscripted play actions and verbalizations from baseline. *Maintenance/generalization:* Improvements maintained after one week (short-term maintenance probes). One participant did not maintain increases after four weeks (long-term maintenance probes). Both participants increased scripted behaviors with novel toys and in a different setting.
D'Ateno, Mangiapanello, & Taylor (2003)	1 girl, autism; 3 years, 8 mo	Play actions and verbalizations (scripted and unscripted)	• VM: scripted play sequences of tea party, shopping, and baking scenario toys • Minimum one hour delay between presentation of VM and presentation of play materials	*Results:* Play actions and verbalizations increased. There were no increases in unscripted play skills. *Maintenance/generalization:* Not reported.

Table 1: (continued)

Dauphin, Kinney, & Stromer (2004)	1 boy, autism and ADHD[3]; 3 years old	Play actions and verbalizations (scripted)	• VM: Short video clips embedded within computerized schedule of activities modeling a verbal sentence and play action with toy figure. • Corrective prompt procedure	*Results:* The participant met acquisition criteria for scripted play actions and verbalizations. *Maintenance/generalization:* *S*cripted statements and actions combined in novel sequences
Hine & Wolery (2006)	2 girls, autism; 2 years, 6 months and 3 years, 7 months	Play actions with sensory materials	• VM: modeled play actions with gardening or cooking themed sensory play materials • General reinforcement for staying at bin with toys (not contingent on play actions) • Three minute practice sessions with toys after video viewing • Adapted procedure for one participant: practice sessions with prompts and reinforcement (FR1[4])	*Results:* One participant increased actions for both sets play materials, other participant required adapted procedure with one activity. However, once acquired, participants maintained improvements across both play materials without video. *Maintenance/generalization:* Limited results across related yet novel materials and in classroom setting.

Table 1: (continued)

Lydon, Healy & Leader (2011)	5 boys, autism; 3-6 years	Play actions and verbalizations (scripted)	• PRT[5] vs VM • VM: Scripted verbalizations and play actions with toy figurines	*Results:* Although play actions increased for both interventions, PRT resulted in a significantly greater number of play actions. Play verbalizations did not increase for either intervention. Follow up probes were significant for play actions in training environment only. *Maintenance/generalization:* The increase in play actions was significant for PRT but not for VM. Neither intervention resulted in a significant increase in play verbalizations.
MacDonald, Clark, Garrigan & Vangala (2005)	2 boys, autism; 4 and 7 years	Play actions and verbalizations (scripted and unscripted)	• VM: Scripted play of town, ship and house themed toys	*Results:* Both participants met mastery criterion of 80% for scripted play actions and verbalizations. Unscripted play did not emerge. *Maintenance/generalization:* Improvements maintained during follow-up probes (length of time not reported).
Palechka & MacDonald (2010)	2 boys and 1 girl, autism 4-5 years old	Play actions and verbalizations (scripted)	• VM: instructor created videos (ICVs) vs commercially available videos (CAVs)	*Results:* All three children learned scripted play from ICV. Using CAVs, two participants did not increase functional play in a reasonable amount of time while one did not learn play behaviors at all. Improvements were maintained during mastery probes (without video).

Table 1: (continued)

				Maintenance/generalization: not reported
Paterson & Arco (2007)	2 boys, autism; 6-7 years	Play actions and verbalizations (appropriate and repetitive)	• VM: Scripted play with theme related sets of toys vs unrelated sets of toys • Prompts for attending and praise provided once during each session for appropriate play behavior.	*Results:* Appropriate play actions and verbalizations increased for both related and unrelated toys. *Maintenance/generalization:* Improvements maintained after one week. Appropriate play actions generalized with novel (but related) toys whereas increases in appropriate play behavior with unrelated toys only when the VM was introduced.
Sancho, Sidener, Reeve & Sidener (2010)	1 boy and 1 girl, autism; 5 years, 4 months; 5 years, 11 months	Play actions and verbalizations (scripted and unscripted)	• VM: simultaneous VM (*with* supplementary instruction during training) vs traditional VM (*without* instruction during training of scripts)	*Results*: Both VM procedures were effective in teaching play skills for both participants. Unscripted vocalizations emerged for one of two participants, but were repetitive and appeared stereotypic. *Maintenance/generalization:* Maintenance and limited generalization of scripted and unscripted actions to similar play sets.
Tereshko, MacDonald & Ahearn (2010)	4 boys, autism; 4- 6 years	Construction of toy figurines	• VM: full sequence vs segmented version of building Mega Bloks® monster characters	*Results:* One participant successful with full sequence video; Three participants required segmented video to increase toy construction behaviors.

Table 1: (continued)

			• Edibles provided regardless of performance at end of session • Response block procedure implemented for repeated errors, but no other instructions or prompts were given.	*Maintenance/generalization:* Acquired toy construction skills occurred in novel setting (classroom).
Social play				
Buggey et al (2011)	2 boys and 2 girls, PDD-NOS; 4 years	Social initiation, engagement	• VSM[6]: featured each participant socially interacting with peers on playground (playing on tire swing, sand, playing ball)	*Results:* Three of four participants increased initiations. *Maintenance/generalization:* Improvements maintained.
Charlop, Gilmore, & Chang (2008)	2 boys, autism; 8 and 9 years	Parallel play, interactive play, nonverbal initiations and responses	• VM: Scripted conversations about toys • Free play sessions were conducted bi-monthly in which play behaviors were assessed	*Results*: Targeting variation in conversation gave mixed results in play behaviors. *Maintenance/generalization:* Parallel play, approach and interactive play increased across peers with autism. Interactive play increased across peers with and without autism for one participant. Nonverbal initiations and responses increased only slightly across persons and settings for both participants.

Table 1: (continued)

Kleeberger & Mirenda (2010)	1 boy 4 years and 4 mo	Imitation of play activities	• VM: depicted adult "teacher" leading and two adult "children" imitating actions (caring for baby doll, carnival, and construction play set) • prompts and reinforcement were systematically added	*Results:* No increase of imitative behaviors in VM alone. Addition of highlighting, prompting and reinforcement resulted in increases in behaviors. *Maintenance/generalization:* Overall increasing trend for play with untrained stimuli and with novel person/setting.
MacDonald, Sacramone, Mansfield, Wiltz, & Ahearn (2009)	2 boys, autism; 5 and 7 years	Play actions and verbalizations (scripted and unscripted), reciprocal verbal interaction chains, and cooperative play with peers	• VM: Scripted play of zoo, airport or play grill schemes • Both participant and peer partner viewed VM • Typical peers required additional prompting and encouraged to "talk a lot" in order to initiate the script.	*Results:* Scripted actions and verbalizations, reciprocal interaction chains and cooperative play increased. One participant did not improve in unscripted play. The second participant increased more in unscripted verbalizations than unscripted actions. *Maintenance/generalization:* Not reported.
Maione & Mirenda (2006)	1 boy, autism; 5 years 7 mo	Verbalizations (scripted, unscripted, initiations, and responses to peer)	• VM: video vignettes for each play activity (playdoh food making set, cars, tree house) • Prior to first VM session, participant watched videotape and experimenter pointed out "good talking". No further instructions or reinforcements were	*Results:* During VM, scripted verbalizations increased for one of three activities. Additional video feedback and prompting increased verbalizations for remaining activities. Initiations were higher for two of three activities with VM only. Responses to peers increased only slightly compared to baseline levels.

Table 1: (continued)

			provided. • VM first introduced, then systematically added video feedback and prompting (visual and verbal)	*Maintenance/generalization:* Improvements maintained during follow-up probes (7, 16 and 18 days after intervention). There were more unscripted than scripted verbalizations for two of three activities.
Nikopoulos & Keenan (2004)	3 boys with autism; 7-9 years	Reciprocal play and social initiations to play	• VM: peer modeling an initiation of play with adult model (“Let’s play”, taking adult’s hand and playing for 15-s). Simplified version consisted of initiation only. • A simplified version of the video was provided if social initiations did not occur.	*Results:* All participants increased mean duration of time in reciprocal play and reduced latency to engage in social initiations to play. *Maintenance/generalization:* Improvements in reciprocal play either were maintained or increased during 1 and 3 month follow-ups. Initiations to play using new toys also increased. (Note: Generalization probes of initiations were not measured during baseline)
Nikopoulos & Keenan (2007) study 1	3 boys, autism; 6–7 years	Social initiation, reciprocal and imitative play	• VM: Initiations to play by child to adult; video 1 consisted of one modeled behavior (social initiations), additional videos added a engagement in activity with the social initiation for total of 4 videos and 4 behaviors. • General praise and edibles were provided during breaks	*Results:* Reciprocal play increased, latency to make social initiations improved. *Maintenance/generalization:* Behaviors maintained at 1 and 2 months and occurred with untrained (typically developing) peer.

Table 1: (continued)

			between consecutive sessions	
(study 2)	1 girl, autism; 7.5 year	Social initiation, reciprocal and imitative play	• VM: Initiations to play by child to adult; video 3 (social initiations + engagement in activity) replaced video 1 (social initiations) • General praise and edibles were provided during breaks between consecutive sessions.	*Results:* Reciprocal play increased, latency to social initiations decreased only after video 1. *Maintenance/generalization:* Behaviors maintained after 1 and 2 months. Improvements occurred with untrained peer (typically developing).
Reagon, Higbee & Endicott (2006)	1 boy, 4 years old	Play actions (scripted) and verbalizations (scripted and unscripted)	• VM: Scripted play with firefighter, cowboy, teacher or doctor dressup costumes • Both participant and sibling viewed VMs • Sibling said the scripted lines no matter the participant's play behavior	*Results:* The participant acquired the complete script (scripted actions and verbalizations) for one activity and approximately 40-60% of the scripts for the remaining activities. Unscripted verbalizations did not increase. *Maintenance/generalization:* Limited generalization in different setting and with other play partners (Note: baseline generalization probes were not measured).
Taylor, Levin, & Jasper (1999): study 1	1 boy, autism; 6 years old	Verbalizations (scripted)	• VM: Scripted play for sibling and adult using airplane, picnic or dinosaur cars toys • contingent verbal praise and tangibles for scripted comments	*Results*: Participant met the acquisition criterion for scripted comments across all three activities. *Maintenance/generalization:* Not reported.

Table 1: (continued)

study 2	1 boy, autism; 9 years old	Verbalizations (scripted and unscripted)	• VM: scripted play for adult model only (sibling not provided with script) using batman colorforms, cars track or marines toys • Forward chaining • contingent verbal praise and tangibles for scripted or unscripted comments	*Results*: Participant met the acquisition criterion for scripted comments across all three activities. Unscripted comments increased and surpassed scripted comments for 1 of 3 activities. *Maintenance/generalization:* Not reported.

[1] PDD-NOS = Pervasive developmental disorder-not otherwise specified
[2] VM = video model
[3] ADHD = attention deficit hyperactivity disorder
[4] FR1 = fixed ratio 1
[5] PRT = Pivotal Response Theory
[6] VSM = video self modeling

The remainder of chapter 2 is organized into three sections of results, discussion and future research. The results section presents an overview of the outcomes according to the two categories: solitary and social play. The summary of the literature in each category is followed by detailed descriptions of two studies representative of each category. Finally, discussion and suggestions for future research are presented.

RESULTS

Solitary Play

Ten studies (n =24 children) targeted play involving only the child (Boudreau & D'Entremont, 2010; D'Ateno, Mangiapanello & Taylor, 2003; Dauphin, Kinney & Stromer, 2004; Hine & Wolery, 2006; Lydon, Healy & Leader, 2011; MacDonald, Clark, Garrigan & Vangala, 2005; Palechka & MacDonald, 2010; Paterson & Arco, 2007; Sancho, Sidener, Reeve & Sidener, 2010; Tereshko, MacDonald & Ahearn, 2010).

MacDonald, Clark, Garrigan and Vangala (2005) used video modeling to teach two boys with autism, 4 and 7 years old, play scripts using figurines and objects of town, ship and house themed toy sets. Four dependent variables were measured: scripted play actions, unscripted play actions, scripted verbalizations, and unscripted verbalizations. Scripted play actions consisted of motor responses that matched the actions of the video model and resulted in the same change in the environment. These actions included moving the toy figurines as if they were engaged in specific actions (e.g., making the figurine open the door of the play house). Scripted verbalizations were single words or short phrases that matched (or were similar enough) to the statements in the video model.

Unscripted actions and verbalizations were motor and verbal responses that did not match the video model. Researchers videotaped an adult acting out each play sequence consisting of approximately 14 pretend play actions and 16 verbalizations. After viewing the video two consecutive times, participants were given a 4-minute opportunity to play with the toys shown in the video. Both children demonstrated increases in scripted actions and verbalizations and learned to appropriately manipulate the characters and talk for them. Prior to video modeling, some unscripted play occurred but were anecdotally characterized as repetitive and unrelated to any storyline or thematic play (e.g., having a character going up and down the stairs repeatedly). After video modeling was implemented, unscripted actions and verbalizations did not occur.

Lydon, Healy and Leader (2011) compared pivotal response training (PRT) and video modeling to teach pretend play skills. Five children were exposed to both conditions in a counterbalanced fashion. The video model intervention consisted of watching a 1-min and 30-s video depicting twelve play actions and verbalizations. The video model was shown to the participants two consecutive times prior to 4-minute play sessions. The PRT intervention consisted of half hour play sessions in which the experimenter followed several guidelines identified prior to the start of the intervention (e.g., the experimenter modeled symbolic play actions and verbal statements, encouraged turn taking with preferred toys, reinforced the participant for approximations and imitations of the model, discouraged stereotypic play and encouraged more complex play by interspersing functional play with more difficult symbolic play). There were no significant improvements for verbalizations for either intervention. Participants in both interventions, however, improved in pretend play actions. Paired samples *t*-tests were conducted comparing the mean differences of PRT and video modeling for verbalizations and play actions in training and generalization environments. The PRT intervention resulted in statistically significantly more play actions than video modeling in the generalization environment only. All other tests were found to not be statistically significant. Additionally, video modeling resulted in 2 of 5 participants reaching the 90% mastery criterion. It is important to note that there was no mastery criterion set for the PRT intervention.

Social Play

Nine studies (n = 20 children) targeted play with two or more persons (Buggey, Hoomes, Sherberger & Williams, 2011; Charlop, Gilmore & Chang, 2008; Kleeberger & Mirenda, 2010; MacDonald, Sacramone, Mansfield, Wiltz & Ahearn, 2009; Maione & Mirenda, 2006; Nikopoulos & Keenan, 2004; Nikopoulos & Keenan, 2007; Reagon, Higbee & Endicott, 2006; Taylor, Levin & Jasper, 1999).

Maione and Mirenda (2006) used multiple video models to teach language skills associated with toy play to a 5 year-old boy with autism, Ryan. Three toy sets (e.g., Play Doh, toy cars and tree house) were utilized in a multiple baseline across activities design. A total of nine videos were developed, three for each of the toy sets. The videos were approximately 1.5-minutes long and consisted of two adults playing with the toys and talking to each other using a variety of comments, questions, acknowledgments, initiations, and responses in 3-6 word phrases. During intervention with the first toy set, Ryan watched the three videos associated with the toy. Then a peer without disabilities joined him for a 15-min play session. The children were told, “time to play [activity]” and directed to one of the three sets of play materials. Every 5 minutes the children were transitioned to a set of toys. Researchers measured scripted and unscripted verbalizations, initiations towards peers, and responses to peers. Initiations were comments or questions that were not contingent on a peer’s utterance and included requests, compliments, and comments about an object or the ongoing activity. Responses to peers were defined as verbalizations that were contingent on a peer’s immediate utterance including acknowledgements, agreements, comments about the ongoing activity, and questions related to a peer’s comments. Five phases were conducted: baseline, video modeling, video modeling plus feedback (play doh and cars only), video modeling plus feedback and prompting (cars only), and follow up. Feedback consisted of showing the Ryan a video of himself and a peer engaging in the play activities. The researcher then occasionally paused the tape and asked Ryan to evaluate his behavior in the video for “good talking” or “not good talking”. During prompting, verbal and visual prompts were used initially and then faded over time. When only video modeling was used, researchers saw improvement for unscripted and scripted verbalizations and initiations for the tree house toy set only. When video feedback was added, levels of initiations, unscripted, and scripted verbalizations improved; however, the data were still variable for one activity (cars). For this set of toys only, prompting was added leading to increased initiations, unscripted, and scripted vocalizations. Responses to peers verbalizations, however, did not increase for any of the toy sets across any of the phases. Follow up several weeks later indicated that improvements across skills and toy sets maintained.

MacDonald et al., (2009) taught two boys, 5 and 7 years to engage in sequences of reciprocal play with typically developing peers. Play was centered around three play sets (e.g., airport, zoo and barbeque grill set) consisting of a base structure and several characters and objects. Three videos were made, one for each toy. In the video, two adults matched for gender of the participant and peer, acted out scripts containing 14 to 17 play actions and accompanying verbalizations. Scripts consisted of manipulating the characters and "speaking" for them such that the characters were interacting or conversing. Four-minute play sessions were conducted in baseline, training and probes. Six variables were measured: scripted play (actions and verbalizations), unscripted play (actions and verbalizations), cooperative play and reciprocal verbal interaction chains. Scripted and unscripted play was measured throughout the study while cooperative play and reciprocal chain interactions were measured only in baseline and mastery. During baseline, the participant and peer were allowed to play with the toy set for 4 min. During video modeling, the pairs watched the video twice and then were immediately provided with the toy from the videos. No prompts or reinforcement were given. After the participant met mastery criteria, mastery probes were conducted without the video model. Follow up probes were conducted 1 month following mastery. Similar results were reported for both participants. Therefore, only one participant's result will be discussed. Both scripted actions and verbalizations increased with the introduction of video modeling, indicating acquisition of the script. Cooperative play, defined as being within close proximity with another peer and engaging in the same activity, increased from 17%, 0.06% and 15% of intervals during baseline for the airport, zoo and grill to 87%, 85% and 90% respectively. Reciprocal verbal interaction chains, defined as a sequence of two or more verbalizations between the participant and peer, increased from 0 sequences in baseline to means of 5 for the airport and 6 for the zoo and grill during mastery probes. These sequences were not only increased in frequency, but the mean lengths of interaction were 7.5 s, 10 s and 7 s, for the airport, zoo and grill. These outcomes were maintained at follow-up probes. Results for unscripted behaviors, however, were mixed as one participant demonstrated increased unscripted play for two of the toy sets while the second participant did not show any improvements.

DISCUSSION

The results of this review suggest that video modeling is an effective intervention for teaching play skills to children with ASDs. This conclusion corresponds with positive findings from other reviews on video modeling (McCoy & Hermansen, 2007; Shukla-Mehta et al., 2010). Specifically, video modeling was effective for 88% of participants in increasing scripted play actions and vocalizations. For the remaining participants, additional prompts or reinforcement resulted in improved play behaviors. Video modeling also increased social skills such as initiations (Buggey et al., 2011; Maione & Mirenda, 2006; Nikopoulous & Keenan, 2004) and reciprocal play (Nikopoulos & Keenan, 2004; 2007). Play often included using themed sets of toy items (e.g. construction set with vehicles and toy figurines). Functional and pretend play were the most common skills targeted. Functional play included using toys as their intended function (e.g., throwing or bouncing a ball) or in a conventional association of two objects (e.g., putting plastic food on a spoon). Pretend play (also called symbolic play), according to Baron-Cohen (1987), included using an object as if it were another object (e.g., using a ball as if it were a cannonball), attributing properties to an object which it does not have (e.g., using the spoon as an extension of a robot) or referring to absent objects as if they were present (e.g., make believe food on the spoon). Additionally, an advanced form of pretend play is sociodramatic play in which children take on characters or roles and act out real life experiences, fantasy and drama. Nearly half of the studies involved sociodramatic play which were taught in both solitary and social play situations (MacDonald, Clark, Garrigan & Vangala, 2005; MacDonald et al, 2009; Maione & Mirenda, 2006; Reagon et al., 2006; Taylor et al., 1999). Targeting such skills aligns with the needs of individuals with autism who characteristically demonstrate little sociodramatic play. In addition to functional and pretend play, a variety of social skills were targeted in studies classified as cooperative play studies. These skills could be considered foundational to playing with others and included initiations to play, responding to others' initiation bids, imitation skills and reciprocal play. In these studies, play skills were not necessarily the focus of the behavior. Instead, play activities were utilized as a vehicle for teaching social skills. For example, Buggey et al. (2011) assessed children's social initiations towards peers during recess on the playground or in the sandbox, Nikopoulous and Keenan (2004) evaluated reciprocal play during play with a ball and a trampoline while Kleeberger and Mirenda (2010) measured imitation of others while singing songs and toy play. Targeting these skills led to collateral increases in cooperative play (Charlop, Gilmore, & Chang, 2008) and reciprocal play (Nikopoulos & Keenan, 2007). However, results should be interpreted cautiously as they are preliminary and a direct manipulation of the effects on these skills was not conducted.

Half of the studies used adults exclusively as the model in the video. Three studies used adults as models even though the play session was with a peer or sibling (Charlop et al., 2008 Kleeberger & Mirenda, 2010; MacDonald et al., 2009). For example, in the study conducted by MacDonald et al. (2009), the models in the videos were two adults matched to the genders of the participant and peer play partners. Adult models may be selected out of convenience, as they are easy to recruit and direct. Siblings or peers were utilized as models in four studies in which three were categorized in the social play category (Buggey et al., 2011; Reagon, Higbee & Endicott, 2006; Nikopoulos & Keenan, 2007). Mixed models consisting of both children and adults were represented in three studies (Nikopoulos & Keenan, 2004; 2007; Taylor et al., 1999). Regardless of whether the models were only adults, only children or a mixture of adults and children, the video model interventions generally resulted in positive outcomes for acquisition of play behaviors. These results support conclusions from previous research that successful video model interventions have been achieved regardless of the type of model that is used (McCoy & Hermansen, 2007). However, given the importance that learned play skills are used with other children, involving siblings and/or peers may be a method to naturally program for generalization. Researchers did not highlight the extents to which the type of model affected generalization. Potentially, there were other positive collateral effects for involving peers and siblings as the model and play partner as well.

Reagon, Higbee and Endicott (2006), for example, reported that after the participant's brother was involved as a model, the sibling felt that "playing with his brother was fun and he learned how to play with him". Often, including siblings during interventions with children with autism can result in positive changes in familial relationships (Ferraioli, Hansford & Harris, 2012).

Twelve studies reported video durations, ranging from 20-s to 4 minutes, although nine of these studies reported durations of 2 minutes or less (Boudreau & D'Entremont, 2010; Hine & Wolery, 2006; Lydon et al., 2011; Maione & Mirenda, 2006; Nikopoulos & Keenan, 2004; 2007; Paterson & Arco, 2007; Reagon et al., 2006; Sancho et al., 2010). These video lengths are shorter than the recommendations of other literature on video based interventions (e.g., video prompting), which recommend using video clips between 3 and 5 min (Banda et al., 2007; Shukla-Mehta et al., 2010). Of the remaining studies that did not report duration, four studies instead reported number of actions, verbalizations or trials portrayed in the video intervention. The numbers were consistent with the studies that reported both duration of video and number of actions and/or verbalizations (Charlop et al., 2008; D'Ateno et al., 2003; MacDonald et al., 2005; MacDonald et al., 2009; Taylor et al., 1999).

Video modeling was sometimes used in conjunction with other strategies as well. Reinforcement was the most common strategy and usually consisted of verbal praise and/or small edible foods. Noncontingent reinforcement was used to maintain interest and general participation, however it is not know the extent that this is required to garner positive outcomes. Contingent reinforcement was used to increase imitation of the target behaviors in the video (Boudreau & D'Entremont, 2010; Hine & Wolery 2006; Kleeberger & Mirenda, 2010; Sancho, et al., 2010; Taylor, Levin & Jasper, 1999). The second most common component added was prompting during play (Kleeberger & Mirenda, 2010; Hine & Wolery, 2006; Maione & Mirenda, 2006; Sancho et al., 2010). Verbal or visual prompts were either delivered prior to the occurrence of behavior to encourage correct responding or as part of an error correction procedure (i.e., after the child has made an error, the prompt indicates what the response should be). Prompted behaviors were followed by reinforcement. The addition of reinforcement or prompts to the video modeling intervention increased the effectiveness of the overall intervention for studies that incorporated these strategies. For example, Sancho, Sidener, Reeve and Sidener (2010) compared the effectiveness of traditional video modeling and simultaneous prompting during video modeling to teach scripted play actions and verbalizations to two children with autism. During traditional video modeling, a 2-min video of the experimenter manipulating the toys was shown without any other prompts or further instruction. During simultaneous video modeling, researchers physically prompted and reinforced imitated play actions throughout the showing of the video. Prompts were faded and an error correction procedure was also implemented. Play was assessed in which no prompts or reinforcement were provided during a 4-min play session after either video modeling intervention formats. Although both formats increased scripted actions the simultaneous video model format increased scripted verbalizations in fewer sessions.

In a few cases, more intensive strategies or modifications were required to produce behavior change. Direct feedback (Maione & Mirenda, 2006) or a modified video garnered success (Taylor et al., 1999; Tereshko et al., 2010). For example, Tereshko, MacDonald and Ahearn (2010) taught two students to construct toy monsters out of blocks. However, one student required modification of the video so that each step was shown as a separate video rather than one full length video. Segmented videos (video prompting) have been effective to teach other adaptive behavior skills. Sigafoos et al (2005) taught adults to use a microwave by showing video of one step, having the individual complete the step and then showing video of the next step. In both of the studies, the nature of the task required that steps were completed in a specific sequence to reach an end goal. Although this type of play skill was different than many of the other studies utilizing video modeling and play, it is possible that certain participant characteristics (e.g., memory, attending, imitation skills) may influence which format would be more appropriate and/or effective. These abilities may need to be assessed to determine participants who will likely benefit from a video modeling intervention. Tereshko, MacDonald and Ahearn (2010) for example, also assessed delayed match-to-sample skills prior to the intervention. They found that the participants who performed poorly on this task also performed poorly using full sequence video modeling. Instead, these participants were more successful with the segmented video modeling format. Although these results are preliminary in nature, they suggest there may be prerequisite skills required for success with the traditional video modeling format. For example, an individual with fleeting attention may require the shorter video clips in video prompting rather than the traditional whole video format for a video modeling intervention to be effective. Although the traditional video modeling format may not be fit for some children, but it is encouraging that relatively simple modifications may make the intervention more effective.

Of the twelve studies that reported maintenance results, all described some continued improvements post-intervention for at least one participant. Maintenance probes for general interactions (e.g., responding to a peer's bid for play) were assessed after several months and resulted in positive effects in three studies. For example, children continued to show improvements with reciprocal play three months following intervention (Nikopoulous & Keenan, 2004) and with initiations almost three weeks following intervention (Maione & Mirenda, 2006). Maintenance probes for behaviors more specific in nature (e.g., scripted actions) were most commonly assessed after 1-2 weeks and also generally gave positive effects. However, in one of the few studies that assessed for maintenance longer than two weeks following intervention, researchers reported a return to baseline in four weeks following intervention for one of two participants for scripted and unscripted play actions (Boudreau & D'Entremont, 2010). The second participant, demonstrated positive results for both maintenance probes. Given the absence of longer term maintenance assessments and general scarcity of studies that reported maintenance effects, the strength of conclusions regarding effects over time is limited.

The evidence for generalization of learned play behaviors across various stimuli is at best, mixed. Sancho, Sidener, Reeve and Sidener (2010) noted limited generalization across novel items. However, Paterson and Arco (2007) reported results indicating that generalization may be affected by how similar the novel items are to the toys used in training. Paterson and Arco taught two boys with autism to play with toys and then assessed generalization with novel toys. When the novel toys were related along the same theme as the toys used in the training phase, one participant generalized verbal and motor play behaviors to the novel toys. However, when the novel toys were thematically unrelated to the toys in the training phase, the second participant did not demonstrate generalization of play behaviors. Paterson and Arco concluded that the generalization should be assessed in a more systematic fashion, taking into consideration which types of toys are used. These results are consistent with conclusions in previous research that generalization may be fostered through the use of novel stimuli that are similar to training stimuli. Caution is warranted in the generality of the results, however, given that intervention effects were only demonstrated within participant rather than across the two participants. Still, this explanation may help explain the lack of generalization seen by Sancho and colleagues, who assessed for generalization using circus themed toys when the toys in intervention were house themed. Generalization of play skills across settings gave mostly positive results (Kleeberger & Mirenda, 2011, Tereshko et al., 2010; Reagon et al., 2006; Dauphin et al., 2004; Sancho et al., 2010). However in one study, Hine and Wolery (2006) reported limited generalization with one of two toys in the classroom generalization probe. They noted that the participant appeared to have satiated on trained stimuli and the added distraction of ongoing classroom activities may have contributed to these results.

The findings for response generalization of toy play are limited. Participants generated unscripted actions more often than unscripted verbalizations. This finding is logical for individuals who have difficulties or delays in communication and language skills. Several studies reported differing results (e.g., one participant showed improvement while another did not) in unscripted or spontaneous play behaviors (Boudreau & D'Entremont, 2010; MacDonald et al., 2009; Taylor et al., 1999) while three studies found little or no improvements at all in unscripted actions and verbalizations (D'Ateno et al., 2003; MacDonald et al., 2005; Reagon et al., 2006). All of these studies highlighted the substantial lack of unscripted play as a major concern with video modeling interventions used to teach pretend play.

There are a number of hypotheses for the lack of spontaneous play skills. One hypothesis is that too many showings of the video could lead to limited unscripted responding. Boudreau and D'Entremont (2010) noted that the introduction of video modeling with reinforcement resulted in decreased performance in unscripted play behaviors. They hypothesized that perhaps too much direction could have lead to inflexible play. In the study by Reagon, Higbee, and Endicott (2006), contextually appropriate unscripted verbalizations emerged in the first 13 of 21 sessions. However, as the sessions continued, unscripted vocalizations decreased even though the participant's play partner continued to model appropriate unscripted verbalizations. It is possible that the extended number of video model sessions in some way affected the maintenance of emerging behaviors. Another hypothesis is that repeatedly showing only one video model example of an activity could somehow limit responding. D'Ateno, Mangiapanello and Taylor (2003) used only one vignette video model per activity and reported no increases in novel responding whereas Maione and Mirenda (2006) used multiple vignettes or scripts for each play activity and reported higher unscripted verbalizations than scripted verbalizations with one participant with autism. Although the increases cannot necessarily be attributed to the use of multiple exemplars, it is certainly plausible as the use of multiple exemplars is a recommended generalization strategy (Stokes & Baer, 1977).

The positive outcomes for spontaneous play behaviors were not without limitations. Sancho et al., (2010) reported unscripted verbalizations that were repetitive or stereotypic in nature. Reagon, Higbee, and Endicott (2006) initially saw increases in unscripted words but these outcomes were not sustained throughout the intervention. Therefore, some researchers may question the qualities of the gains on spontaneous play behaviors as mere imitation rather than "true" play (Jarrold, Boucher & Smith, 1993; Luckett, Bundy & Roberts, 2007). Play is a complex activity involving the intertwining of cognitive, social, and emotional and language skills. Impairments in these areas, which are characteristic of autism spectrum disorders, often lead to abnormal play development. Behavioral methods for teaching play often are criticized for being too structured or adult-led (Frost, Wortham & Reifel, 2005). However, interventions that are behaviorally based are successful with individuals with autism. Therefore, one must consider how to carefully balance these issues when it comes to teaching play skills.

FUTURE RESEARCH

Although current research supports the use of video modeling to teach play skills to children with ASDs, there is always room for improvement. Many of the studies took place in home and school settings. However, even within the school setting, participants were administered the intervention on an individual basis. Given the relative simplicity of video model interventions, future research should “scale up” and explore use of this mode of instruction with small groups of children or as part of the curriculum lesson for pullout type of services common in special education of public schools. Additionally, researchers may want to specifically focus on increasing unscripted play. For example, given the potential relationship between number of viewings and lack of spontaneous play highlighted previously, future studies should address the optimum number of viewings needed to strike a balance between acquiring behaviors and fostering spontaneous play. If repeated viewings of video models and specific reinforcement schedules have negative effects on creative responding as some of the researchers have posited, perhaps this balance in which video models are shown should be highlighted in order to expand on the effectiveness of video modeling interventions and play. Other behavioral strategies associated with increasing spontaneous responding could be applied and combined with video modeling. For example, script fading has been very effective in the production of unscripted social interaction skills (Krantz & McClannahan, 1998; Wichnick, Vener, Pyrtek & Poulson, 2010). In theory, a similar use of video modeling might be explored in which the video model is faded or cut shorter over time. Another area to consider is the type of reinforcement schedule employed, given that reinforcement was commonly the additional component used. Although fixed or variable ratio schedules of reinforcement are often used to teach new skills, there is evidence in the basic research which suggests that increasing variability of responding may lead to behaviors that are not explicitly taught. For example, lag schedules could potentially be used to enhance video model interventions. Lag schedules are a type of differential reinforcement schedule with a multitude of evidence in the basic arena for increasing variability and novel responding of nonhuman subjects. However, the research involving lag schedules is severely lacking in the applied research.

In order to address the lack of unscripted play in the current video modeling and play research, the current experimental study employed the addition of a lag schedule of reinforcement with video modeling to increase toy play. The remaining chapters 4, 5, and 6 outline the method and procedures used, results, and discussion, respectively.

Chapter 3: Method

The purpose of the current study is to investigate the effects of video modeling and lag schedules on toy play skills for children with autism. This chapter introduces the methods for this study. First, participants, setting and materials are described. Next, the dependent variables, independent variables, and procedures for measuring interobserver agreement and procedural fidelity are introduced. Finally, the procedures, experimental design and social validity assessments are discussed.

PARTICIPANTS

Five children with autism participated in this study. All participants were recruited through the local county services provider or private behavioral clinic. They were referred for the study because parents or therapists described their play as child's play skills with toy figurine sets as few or inappropriate (e.g., child plays with a toy in a nonfunctional or repetitive manner such as repeatedly having a toy animal go down the slide without interspersing other play actions) and warranted intervention. Each child was assessed on the Vineland Adaptive Behavior Scales-II (Sparrow, Cicchetti, & Balla, 2005) and Childhood Autism Rating Scale 2 (CARS2-ST; Schopler, Van Bourgondien, Wellman, & Love, 2010). Table 2 reports a summary of the participants' information, including age, ethnicity, and assessment scores.

To be included in the study, the participants were informally tested to confirm they could imitate actions from a video. The children were shown a 10-20-s video of a person conducting simple tasks (e.g. putting a block on a cup, turning a cup upside down) with toys from the child's home. Immediately after the video, the participant was presented with the same materials, set up similarly to the video and instructed to "do like the video". Only participants who attempted at least 50% of actions were included in this study.

Bruce was a 10-year old Hispanic boy with autism. He scored a 41 on the CARS2-ST, which placed him in the severe symptoms of autism range. His functional adaptive functioning range was classified as low on the Vineland Adaptive Behavior Scales II. He communicated using 2-3 word phrases that were almost always to request items. He attended a public school in a self-contained classroom. Bruce enjoyed puzzles, movies and an alphabet puzzle in which he would label the color and letter. Reinforcers in the video model with lag schedule phase for Bruce were small hard candies.

Natalia was a 5-year old Caucasian and Hispanic girl diagnosed with autism. Natalia scored a 34.5 on the CARS2-ST, which placed her in the mild to moderate symptoms of autism range. Her general adaptive functioning level was classified as low according to the Vineland Adaptive Behavior Scales II assessment. She spoke in two to three word sentences (e.g., "I want popcorn"), enjoyed puzzles, flipping through picture cards in which she would label the characters and often script phrases from cartoons. Reinforcers in the video model with lag schedule phase for Natalia included popcorn and fruit.

Clint was a 5-year old Caucasian boy with autism. He scored a 30.5 on the CARS2-ST, which placed him in the mild to moderate symptoms of autism range. His functional adaptive functioning range was classified as low on the Vineland Adaptive

Behavior Scales II. He received 10 hour/week ABA therapy in the clinic and home. He communicated using 4-5 words and often repeated scripted dialogue or phrases from various cartoons and games. He enjoyed playing games on the iPad, trains and had a preoccupation with railroad crossing signs. Reinforcers in the video model with lag schedule phase for Clint included chocolate chips and “fish crackers” (goldfish).

Steve was a 4-year old Caucasian boy with autism. He scored a 35 on the CARS2-ST, which placed him in the mild to moderate autism symptom range and general adaptive functioning range classified as low on the Vineland Adaptive Behavior scales II assessment. He attended a private school for individuals with learning and speech difficulties. He also participated in OT therapy and ABA therapy in the home and clinic settings. Steve communicated using full sentences and often repeated phrases heard in regular conversation. He enjoyed playing with cars, legos and trains. Reinforcers in the video model with lag schedule phase for Steve included fruit snacks and pretzels.

Tony was a 4-year old Caucasian boy diagnosed with autism. Tony scored a 29.5 on the CARS2-ST, which placed him in the minimal to no symptoms of autism range. His general adaptive functioning level was classified as moderately low according to the Vineland Adaptive Behavior Scales II assessment. He attended a three hour preschool program for children with disabilities (PPCD) in the mornings and occupational therapy in the afternoon. He spoke using full sentences and was able to answer some simple “Wh“ questions. He enjoyed playing cars and trains and his mother reported that he could do so for hours. During independent play, he was observed to repeat phrases he had seen from a video game or movie while manipulating the toys, but would also add his own dialogue on occasion. Reinforcers in the video model with lag schedule phase for Tony included goldfish and small pieces of potato chips.

Table 2: Participant characteristics

Participant	Age	Ethnicity and gender	CARS2-ST	Vineland adaptive functioning level
Bruce	10	Hispanic; male	41 (severe symptoms)	Low
Natalia	5	Hispanic/Caucasian; female	34.5 (mild to moderate symptoms)	Low
Clint	5	Caucasian; male	30.5 (mild to moderate symptoms)	Low
Steve	4	Caucasian; male	35 (mild to moderate symptoms)	Low
Tony	4	Caucasian; male	29.5 (minimal to no symptoms)	Moderately low

SETTINGS

Sessions were conducted in a room within each of the participant's homes (e.g., play room, bedroom or living room). The attempt was made to minimize distractions by keeping the play area free from toys not used in the study. The toy base was placed on the floor play (except for Clint, who preferred to play while standing with the toy base on a table) and the child was allowed to play within several feet surrounding the toy base. If the child attempted to leave the play area, he or she was redirected back towards the toy. In most cases, only the researcher and child were present, although on occasion the mother, caregiver or sibling of the child participant may have been nearby or in an adjoining room (e.g., kitchen or dining room).

MATERIALS

Toys

The Fisher Price Little People© zoo animals play set with a car, two animals and zookeeper figurines were used for all participants throughout the study. The play set included features that were functional in nature (i.e., slide, moveable basket swing and other moving components like buttons and a gate that opened and closed). The inclusion of the figurines allowed the child to also engage in more complex play such as dialogued or pretend play. Although the toy could produce electronic sounds with certain actions using the toy figurines, this option was turned off throughout the study.

Video equipment

All intervention sessions and the video model were videotaped with a small digital camera with video capabilities (Canon PowerShot SD 980 IS) mounted on a small tripod. The video model was shown on a 1st generation Apple iPad.

DEPENDENT VARIABLES AND MEASUREMENT

Play actions were defined as discriminate actions using the toy figurines on objects in ways in which they were intended to be moved (e.g., pushing a swing, placing figures in the tree; Frey & Kaiser, 2011). This generally included two types of actions: 1) placing a figurine on or around the toy base (e.g., putting the lion in the swing) for at least 1-s or 2) manipulating the toy or toy base such that an action occurred (e.g., have the lion "walk" or "fall" off the swing). Neither indiscriminate actions (e.g., mouthing or banging items) or actions to repair a situation (e.g., placing the gorilla back in the car after it falls out while the child is driving the car) were coded. Some play actions were discrete with a clear beginning and end (e.g. placing a character down the slide or tilting the leaf so that the character falls off). Other play actions did not have a clear beginning and end (e.g., driving the car, spinning the treetop). These were considered two actions if they were separated by at least a 3-s pause or a different action. Indiscriminate actions were also scored if accompanying verbalizations made it clear some form of pretend play was occurring. For example, moving the lion face down on the ground and then making an eating sound or comment (e.g., "yummy pomegranate!").

For each child, a list of play behaviors was developed. The list included topographies of play behavior that were operationally defined by three components: characters/agents, the location on the toy, and the specific child behavior. Each topography was also given a numerical code that was later used for coding of varied play actions. See Appendix A for a combined list of behaviors and codes.

Data were collected for three dependent variables: varied, scripted, and unscripted play actions. To do so was a several step process. All coding was conducted using the videotaped sessions. First, the researcher watched each video and recorded the approximate video time of occurrence and a short description of the play action (e.g., agent or character used, place on the toy and child's behavior). The ongoing list of play topographies was developed for each child from this process. Additionally, a numerical code was assigned to each play topography. These numerical codes were used to code whether an action was a varied action. Varied play actions (adapted from Napolitano et al., 2010 and Frey & Kaiser, 2011) were defined as play actions that were different in form from the two immediately previous actions during the session. Using a different character to perform the same action was not considered a varied action. For example, placing the zebra on the treetop was not considered a varied action from putting the lion on the treetop. Varied actions were therefore scored if the play code (which designates only a topography) differed from the two previous numbers on the record.

Actions were also scored as scripted or unscripted. Scripted play actions were actions that matched those in the video model script (agent, place and action). Unscripted play actions differed from the script but were appropriate to the toy. This included using a different character to perform a scripted action. Scripted and unscripted play topographies or actions were measured by frequency of first time occurrences per session. If a topography was repeated at anytime during the play session, it was coded as scripted or unscripted but designated as repeated by placing it in parentheses. When counting the number of scripted and unscripted play behaviors in each session, only those that were not in parentheses were tallied.

INTEROBSERVER AGREEMENT (IOA)

Interobserver agreement data were collected on varied play actions, scripted actions, and unscripted actions. These data were assessed for at least 20% of sessions across all conditions for each participant. Each video was initially coded by the researcher as described previously. Prior to reliability coding, the two coders reviewed the list of play topographies and scripted play behaviors. The second coder was given IOA data sheets with the described play action and times, corresponding numerical codes and scripted/unscripted designations already printed (See appendix C for an example of the coding sheet). If the second coder agreed that the play action occurred during the listed time, they marked “A” or “agree”. If the second coder did not observe the same behavior or observed a different behavior, they marked “D” or “disagree”. Additionally, space was given to write down other play actions that occurred but were not marked by the first coder. Since the coders had already agreed on the list of numerical codes and list of scripted play, any discrepancies were coded (numerical code, classified as varied, scripted/unscripted) and tallied. IOA was calculated using the total agreement approach. For each of the dependent variables, the smaller number was divided by the larger number and multiplied by 100 to give a percentage (Kennedy, 2005). The mean IOA combined across all sessions and participants for varied actions was 98.9 % (range, 86%

to 100%), for scripted actions IOA was 99.6% (range, 88% to 100%) and for unscripted actions IOA was 97.94% (range, 70% to 100%).

INDEPENDENT VARIABLES

The independent variable consisted of two components: video modeling and a lag 2 reinforcement schedule.

Video model

The video model was a 30-40 second video created by the researcher showing an adult's hands manipulating the toy base and characters in twelve sequenced play actions along a storyline. Although the video included accompanying verbalizations, data were not collected on the children's imitation of verbalizations. The scripted play actions are listed in Appendix B.

Lag 2 schedule of reinforcement

A lag 2 schedule of reinforcement is a type of differential reinforcement schedule in which specific responses that meet a criterion are reinforced while other responses are ignored. In order for a response to be reinforced, it must be different in topography from the two previous responses. In this study, the researcher provided the child with verbal praise (e.g., "good playing") and small amounts of preferred edible reinforcers for play actions that were different from the last two play actions emitted. For example, if the child put the lion figurine down the slide (action 1) and then through the gate (action 2), the child would be reinforced if the next action was different from the two previous actions (any other play action besides placing the lion down the slide or through the gate). However, if the participant puts the lion down the slide again as action 3, no reinforcement would be given as this third action would be the same play action as action 1. No directions or prompts regarding manipulation of the toys will be provided.

Fidelity of Procedures

Fidelity of procedures was assessed for 20% of sessions that were randomly selected for each participant in baseline, video model and video model with lag schedule phases. A task list of the procedural steps for each phase was developed. The independent observer completed the fidelity checklist (Appendix D) for the appropriate intervention phase, marking the occurrence of steps as “correct”, “incorrect” or “n/a”. Procedural fidelity was calculated by dividing the number of steps scored correct by the total number of steps observed and multiplied by 100 to give a percentage. The mean fidelity across participants for baseline was 100%, for video modeling was 100%, and for video modeling with lag schedules was 100%.

Experimental Design

A nonconcurrent multiple baseline across participants design was utilized to demonstrate experimental control (Christ, 2007; Kennedy, 2005). The numbers of baseline sessions were determined a priori (e.g., 4, 7, 10 and 13 sessions) and the participants randomly assigned to a baseline as they were recruited for the study (Christ, 2007).

Baseline

The child sat in front of the play materials and asked to watch a 30-40-s cartoon video unrelated to the toys. The researcher instructed the child, “Here are some toys you can play with.” The researcher did not provide any other prompts or instructions regarding how to play with the toys. The child was given 5 minutes to independently play with the toys. If the child attempted to leave the area prior to the end of the session, he or she was redirected back to the toys. Additionally, if the child was not oriented towards the toys for 20-30 seconds, he or she was prompted to “play with the toys”.

Video model phase

The video modeling phase was implemented using the same procedures from baseline with the exceptions that the video shown prior to playing was the researcher created video model related to the zoo toy and the participants were given the instruction, “here are the toys…now you can play with them like the video”. The script of the video is presented in Appendix B.

There were slight modifications to these procedures that were implemented for certain children and these were determined on an individualized basis. First, prompts were used in this phase *only* with Bruce. Bruce engaged in stereotypy behavior (e.g., turning and tapping the characters repeatedly). Once it was determined that viewing the video model was not enough to increase play behaviors, blocking these stereotypy behaviors and redirecting him back to the toys (“you can play with the toys”) was implemented for the remainder of the study. However, prompts on how to manipulate or play with the toy were still not provided. The second slight modification to procedures was with Steve. Steve, across several video model sessions, attempted the scripted action to tilt the leaf and make the character fall off but was not successful. After several attempts, he would abandon the remainder of the script. Therefore just prior to the sixth video model session, the researcher showed Steve how to manipulate the leaf to make it tilt and had him practice the action several times. He did not require any other instructions or reminders for the remainder of the sessions.

Video modeling with lag 2 phase

The same basic procedures from the video modeling phase were followed, this time with the instruction, “here are the toys you can play with. You can play like the video or however you want”. Also, during the 5-min play session, the researcher provided verbal and edible reinforcement on a lag 2 schedule for variant play actions. That is, for each action that differed from the previous two play actions, the child was given an edible and verbal praise such as, “good playing” or “great job”. No prompts or instructions related to how to play with the toys were provided. After 5 minutes, the child was given verbal general praise and asked to help clean up.

SOCIAL VALIDITY

Social validity for two aspects of the study was assessed. Clinicians assessed aspects of implementing the intervention while parents assessed their own child’s play outcomes.

Intervention components

Three trained clinicians assessed the social validity of the video model intervention and lag schedules. Two clinicians had at least 5 years experience working with individuals with disabilities in home settings and were in graduate school for behavior analysis. The third clinician had several years experience working with individuals with disabilities in the classroom setting but only recently begun more intensive training in behavior analysis. Two video clips (one about implementing video modeling and the other demonstrating the lag reinforcement schedule) were shown to the clinicians, who were then asked to fill out a short questionnaire. Using a 5 point Likert type rating scale (1= "strongly disagree" to 5 = "strongly agree"), they were asked to rate statements about whether they believed they could carry out the intervention components, if they thought learning to do so would take lots of training and the appropriateness of using video modeling and lag schedule reinforcement with young children with autism and in the home/school settings. (See Appendix E).

Play outcomes

To assess the play outcomes from this study, a 1-min video of each child was made. Each video showed two 30-s clips, one from a baseline session and the other after the video model and lag schedule intervention was implemented. (Note: the post intervention clips were taken from maintenance probes that were not reported in this study). Four parents of the child participants participated. The fifth parent was not available for the questionnaire. Parents watched only the video of their child due to confidentiality purposes. Furthermore, the parents were blinded to which phase (pre or post intervention) the clips originated from. After watching the video clips, the parents filled out a questionnaire in which they were asked to identify the video they felt best represented certain qualities of their child's play (e.g., appropriateness of play, variety of play actions, follows a storyline, child's engagement; see Appendix F).

Chapter 4: Results

In this chapter, the results of the current study are described. First, frequency data on varied play behaviors are presented (Figure 1). Next, data on the number of scripted and unscripted play behaviors for each session are presented (Figure 2).

VARIED PLAY ACTIONS

Figure 1 displays the frequency of varied play actions for each child. The top panel shows results for Bruce. During baseline, he demonstrated few varied actions (*M* = 2.25, range 1 to 3). After the video model, varied actions did not increase until blocking was implemented for stereotypy behaviors in session 8, but the general trend increased (*M* = 4.16, range 0 to 11). The video model with lag schedule resulted in an increase in varied actions (*M* = 9.4, range 6 to 16).

The second panel shows results for Natalia. During baseline, she demonstrated some varied actions (*M* = 12.9, range, 10 to 16). Once Natalia viewed the video model, varied actions increased (*M*=19.8, range, 16 to 23). The addition of the lag 2 reinforcement schedule further increased varied actions (*M*=24.3, range, 22 to 26).

The third panel shows results for Steve. During baseline, he demonstrated some varied play actions (*M*=7, range, 1 to 20). The introduction of the video model increased varied play actions (*M*=18.3, range, 13 to 26). Following the lag schedule, varied actions increased only slightly (*M* = 20.5, range, 17 to 24).

The fourth panel shows results for Tony. During baseline, he demonstrated some varied actions (*M*=14, range, 6 to 31). Once the video model was implemented, varied actions almost doubled (*M*=34, range, 30 to 39). However, levels of varied actions decreased when the lag schedule was implemented (*M*= 25.1, range, 19 to 35).

The fifth panel shows results for Clint. During baseline, he demonstrated few varied play actions (*M*=4.4, range, 1 to 10). Viewing the video model increased Clint's varied play actions (*M*=18, range, 10 to 27). Implementation of the lag schedule increased varied play actions slightly (*M*=19.7, range, 12 to 26).

SCRIPTED AND UNSCRIPTED PLAY ACTIONS

Figure 2 presents the number of scripted and unscripted play actions or topographies of play for each session. Scripted play actions are designated by the closed squares while unscripted play actions are designated by the open squares.

The first panel presents results for Bruce. During baseline, Bruce did not demonstrate any of the scripted actions (*M*=0.25, range, 0 to 1) and some unscripted play (*M*=5.75, range, 4 to 7). After viewing the video model, scripted play did not increase (*M*=1.16, range, 0 to 3) while unscripted play decreased slightly (*M*=4.75, range, 1 to 8). However, after adding reinforcement to the video model with the lag schedule, scripted play increased (*M*=6.6, range, 5 to 8) and unscripted play remained at similar levels as during the video model (*M*=4, range, 2 to 7).

The second panel presents results for Natalia. During baseline, Natalia showed few scripted actions (*M*=0.71, range, 0 to 2) and some unscripted play (*M*=12.2, range, 8 to 18). After the video model, scripted actions increased (*M*=7.4, range, 6 to 8). Unscripted play actions decreased slightly (*M*=8.6, range, 7 to 11). Following lag schedules, scripted actions increased (*M*=9, range, 8 to 10) and unscripted actions increased (*M*=11.6, range, 9 to 13).

The third panel presents data for Steve. Steve demonstrated very little scripted play (*M*=0.2, range, 0 to 1) and some unscripted play (*M*=9.8, range, 7 to 22) during baseline. After the video model, play actions for scripted actions increased (*M*=6.25, range, 3 to 11) as well as unscripted actions (*M*=11.87, range, 10 to 15). Lag schedules maintained both scripted actions (*M*=6.8, range, 3 to 9) and unscripted actions (*M*=11.85, range, 10 to 18).

The fourth panel presents results for Tony. During baseline, Tony did not demonstrate scripted actions (*M*=0.92, range, 0 to 2) but did present with some unscripted play (*M*=12.7, range, 6 to 27). Following the video model, Tony's scripted play increased (*M*=10, range, 9 to 11) and unscripted play decreased from baseline (*M*=9, range, 4 to 11). Lag schedules did not serve to increase scripted play (*M*=11, range, 10 to 11), and decreased levels of unscripted play (*M*=6.4, range, 1 to 12).

The fifth panel presents results for Clint. During baseline, Clint did not exhibit scripted play (M=0.06, range, 0 to 1) but demonstrated some scripted play (M=8.75, range, 5 to 12). After the video model, scripted play increased (M=7, range, 5 to 10) and unscripted play remained at similar levels (M=8.5, range, 5 to 11). Following the implementation of the lag schedules, both scripted play (M=8.42, range, 7 to 11) and unscripted play (M=9, range, 5 to 16) neither increased nor decreased.

Figure 1. Frequency of varied play actions for Bruce, Natalia, Steve, Tony, and Clint.

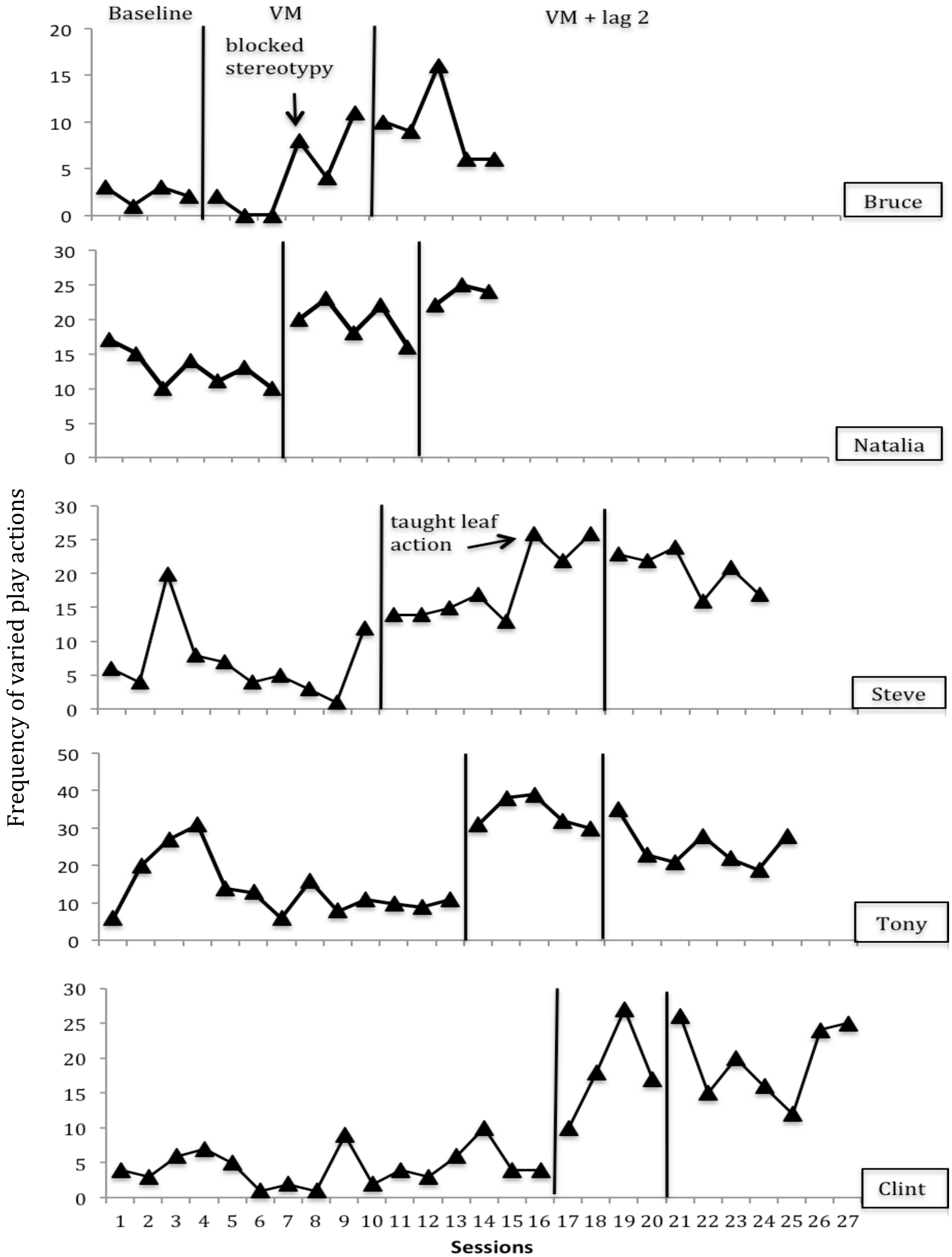
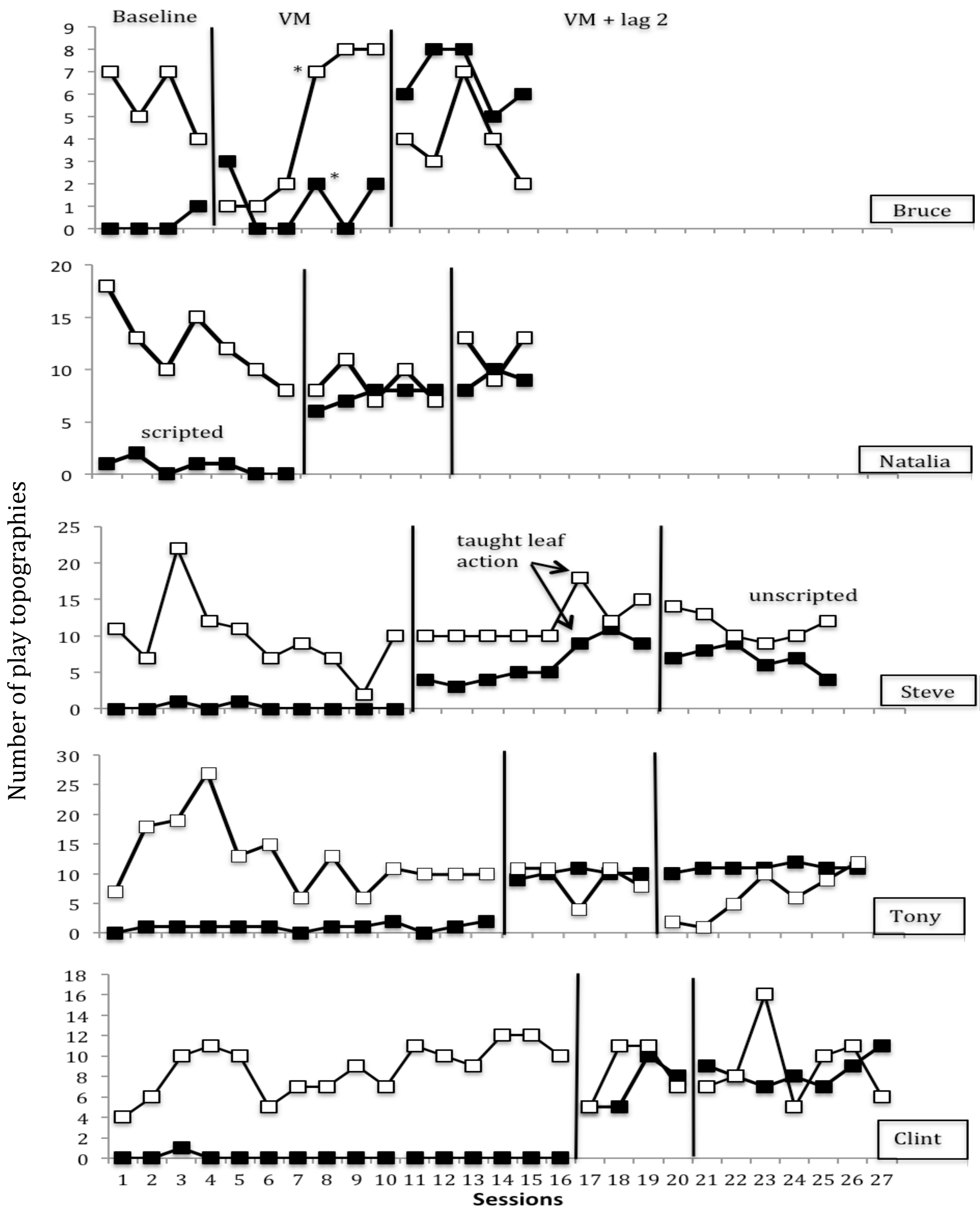


Figure 2: Number of scripted and unscripted topographies of play for Bruce, Natalia, Steve, Tony, and Clint (* indicates start of block and redirection of stereotypy)



SOCIAL VALIDITY

After viewing two short video clips on implementing video modeling and lag schedules, three clinicians with several years experience working with children with disabilities assessed statements about the use and perceived training to implement video modeling and the combination of video modeling with a lag reinforcement schedule. All of the clinicians marked “strongly agree” to statements about that they could carry out the video model intervention and that it was appropriate for teaching play skills to young children with autism in the home or classroom. They also all marked “disagree” for the statement that video modeling would take lots of training. When it came to the lag schedule procedure and use of the combination of video modeling and lag schedules, they also all marked either “disagree” or “strongly disagree” with statements that learning to use a lag 2 schedule would take intensive training or that it would be difficult to carry out. They marked “strongly agree” on statements that the combination of video modeling with a lag 2 schedule of reinforcement was appropriate for young children with autism in the home or classroom.

Parents (i.e., mothers) were asked to identify which video represented certain qualities of their child’s play. Choices included “video 1”, “video 2”, and “not sure”. Unbeknownst to the raters, video 1 was taken post-intervention while video 2 was taken from pre-intervention baseline sessions. All of the mothers correctly identified video 2 as the video taken prior to intervention. They all identified video 1 for statements that the child’s play was: most appropriate for their age, contained more variety of play actions, appeared to follow a storyline, showed the most improvement and the video clip in which the child appeared more engaged with the toy. Parents were also asked to rank (along a 5-point scale in which 1= “strongly disagree” to 5 = “strongly agree”) whether they thought post-intervention play (or “video 1”) looked contrived or unnatural. Three parents rated this question as a 1 or 2 indicating that they did not think the play looked contrived while one parent rated this statement as a 3. Finally, three parents agreed that their child benefited from participating in the study while the fourth parent rated this question a 3.

Chapter 5: Discussion

The purpose of this study was to evaluate the effects of video modeling and the combination of video modeling and a lag schedule of reinforcement on play skills for children with autism. The video model consisted of a person's hands manipulating the toy and figurines by moving and "speaking" for them based on a scripted storyline. The child viewed this video model on an iPad and then was instructed to play with the toys seen in the video. No other prompts or instructions were given on how to play during the session. During the video model with reinforcement combination intervention, the child again viewed the video model but was given reinforcers on a lag 2 schedule of reinforcement. In this specific schedule of reinforcement, only play behaviors that differed from the two preceding responses were reinforced. The purpose of adding this specific schedule of reinforcement was to attempt to increase variability and unscripted play behavior.

This final chapter first addresses the four specific research questions posed in earlier chapters. First, what are the effects of a video model on the variability of play behaviors? Second, what are the effects of the video model on unscripted play? Third, what are the effects of adding a lag schedule of reinforcement to the video model intervention on variability of play behaviors? Last, how does the addition of a lag schedule of reinforcement affect unscripted play? After discussing the results in relation to these four research questions, concluding comments, limitations and future research are presented.

Video model

This section addresses the first two research questions. What are the effects of a video model on unscripted play and on varied play actions? The video model not only increased appropriate play in the form of play that matched the video model (scripted play), but did not appear to interfere with baseline levels of unscripted play. In other words, introducing the video model neither increased nor decreased levels of unscripted play. Although at first glance these do not seem like significant findings, they are indeed. Previous research on video modeling and play suggest a lack of unscripted play after the video model was introduced and this remained the case for the current study. However, because participants in the previous studies demonstrated low levels of unscripted behaviors in baseline (e.g., one to four unscripted actions), it was not clear whether video modeling would interfere with the play of a child with a more established play repertoire (Boudreau, D'Entremont, 2010; MacDonald, Sacramore, Mansfield, Wiltz, & Ahearn, 2009; MacDonald, Clark, Garrigan, & Vangala, 2005).

Varied play behaviors, for the purposes of this study, were defined as play actions that were different from the two immediately preceding play actions, regardless of the toy character used. For example, if a child places the lion in a swing (action 1), then adds a gorilla in the swing (action 2), then moves the lion to the car (action 3), placing the lion in the car would be considered a varied action because it was different from the first two actions (placing the lion and gorilla in the swing). The implementation of the video model intervention served to increase varied play actions. These results can likely be explained because the video model script consisted of play actions in a sequence that met the definition of varied actions. If the child followed the sequence of the script, the level of varied actions would increase. Additionally, learning 8-10 new play actions provided an increased repertoire of play behaviors. The increase in varied actions indicates the children were incorporating these new actions rather than perseverating on a few. This explanation for the increase in variability in conjunction with learning new play topographies point to the question of whether individuals with autism generally exhibit decreased variability due to inherent characteristics or symptoms of the disability or if reduced variability may be due to restricted repertoires of behavior (Lee, Sturmey, & Fields, 2007). Given that individuals on the spectrum tend to require intensive interventions to learn new skills, it is possible that there may be aspects of both in play.

Video model with lag schedule

This section addresses the last two research questions. What are the effects of video model with lag schedules on unscripted play behaviors and variability of play?

The addition of the lag reinforcement schedule did not affect the overall levels of unscripted actions or varied play for four of five participants. There are several explanations for these results. One explanation is that the discrimination for the contingencies of reinforcement did not occur. Because the script was developed along a storyline sequence in which each play action was different from the previous two actions, as long as the child imitated the sequence of actions, criteria for reinforcement would be met without the need to engage in unscripted play. Given that the antecedent conditions were similar to the video modeling phase (i.e., watch the same video model and asked to play), it is possible the child continued to follow the sequence of the script as doing so led to access to reinforcers. Therefore, the opportunity or need to play differently from the script and in a varied fashion may not have been apparent. The results for two participants support this explanation. Bruce predominately showed higher unscripted play over scripted play during video modeling. However, once the lag reinforcement component was added, Bruce's play behavior immediately switched such that scripted play occurred more than unscripted play. Other researchers have reported a similar decrease once reinforcement contingencies are added to video modeling. Boudreau & D'Entremont (2010) provided reinforcers contingent on the participants' imitation of scripted actions and verbalizations and reported a similar decrease in unscripted actions for one child. The effects of adding reinforcement in such a way appears to interfere with unscripted play behavior. Although in the current study, the criterion for reinforcement was not as stringent compared to other studies (i.e., Boudreau & D'Entremont, 2010), the idea that the new play behaviors seen in the video model would be reinforced are the same. Results for the second example of this explanation, Tony, showed an immediate drop in unscripted play during the first three sessions of the lag schedule implementation. Yet his scripted play and frequency of varied actions remained the same as in the video model phase. In fact, he imitated the video model sequence multiple times throughout the 5-minute session, venturing very little outside of the script, which still met the contingencies for reinforcement. However, in the last few video model with lag sessions (sessions 22 through 25), Tony began to move the characters to different places on the toy base and look expectantly at the researcher each time. It appeared that discrimination of the lag schedules was occurring, as indicated in the increasing trend of unscripted play during these last sessions.

For the other two participants who did not demonstrate any increases in unscripted play (Steve and Clint), the addition of the lag schedule did not increase their unscripted play. Again, the requirements of the reinforcement contingency may not have been salient enough or high enough to become salient. Since these individuals demonstrated varied play behavior in baseline, the schedule of reinforcement could have been interpreted as a variable ratio schedule in which a seemingly unpredictable number of responses must occur to meet the criteria for reinforcement. Another explanation might be that the lag schedules indeed were effective; rather, there was an upper limit or ceiling of varied play responses in a 5-minute play session. Further analyses of the percentage of play actions that were varied would be necessary to address this.

Finally, one participant demonstrated a slight increase in unscripted play and varied play when the lag schedule was implemented, which is cautiously encouraging. It is possible that the snacks and praise helped to increase her rates of play, but review of the transcripts of play show that the average number of play actions per session were approximately the same across video modeling and lag schedule phases, indicating this hypothesis may not account for the change.

Implications

Previous research described low levels of unscripted play for children with disabilities. In this study, all of the participants demonstrated some unscripted play in baseline. The toy used in this study had many play areas and working parts that may have encouraged the child to explore and do different things using functional play, at a minimum. For example, there was a moving swing, slide, and several cause and effect buttons that resulted in something occurring when pushed (e.g., squeaking noise, mouth moves). Previous research on video modeling and play studies highlighted concerns of low levels of unscripted play (D'Ateno et al., 2003; MacDonald et al., 2005; Reagon et al., 2006). While this is certainly a concern for children with lacking play skills, it is also possible that the toys used may have not encouraged simple functional play in having very few areas to try different things few working parts. For example, MacDonald, Clark, Garrigan, and Vangala (2009) used a ship base with stairs, a steering wheel, and a crow's nest. Characters and objects included a pirate, sailor, captain, dog, treasure box, cannon, and a telescope. This study reported that the child's unscripted play consisted of moving the figurines up and down the stairs repeatedly. These toy bases would therefore require the child to engage in pretend play (a more complex skill) to see increases in unscripted play (MacDonald, Clark, Garrigan, & Vangala, 2009). Therefore, it may be an important consideration in play studies to choose toys that match the child's level of play.

Using a video model was a relatively noninvasive method to teaching new play skills. Prior to the video model, several of the children manipulated the functional aspects of the toy, but did not always involve the characters. For example, the child opened and closed the flap multiple times or spun the treetop, but did not combine these actions with the toy characters. When the characters were manipulated, they were used as functional objects (e.g., placing a gorilla down the slide). After the video model, the children learned to use the characters in conjunction with the functional moving parts. However, whether the child understood the play as the character "hiding" on the leaf when he or she closed the leaf rather than merely imitating a series of movements seen on a video is beyond the scope of this project. On the other hand, from a behavioral perspective, no other prompts or instructions were required for four of the children to learn new play actions. The fifth child, Bruce, required additional prompts in the form of blocking stereotypy and verbal redirection to increase play. However, specific instructions on how to manipulate the toys were not required. The children were given opportunities to play how they wanted to with the toys and therefore more child-led rather than prompted. The play that resulted may serve as a closer representation to “true” play, which is defined as child-led by some researchers (Luckett, Bundy & Roberts, 2007) and further help alleviate concerns that behavioral approaches to play are too structured. Another observation about the use of video modeling is that the children learned the scripted play actions *without* additional reinforcement. The reason for this is unclear, but one might assume that the children found imitating the video reinforcing or motivating in some way. If this is indeed the case, there are a few advantages to using video modeling over more intrusive methods to increase play. First, building skills that do not rely on extrinsic reinforcement or prompting reduces the need for fading these components out which may help foster generalization or maintenance of new skills. Second, whenever less intrusive instructional methods can be employed, and give effective behavior change, they should be.

This study extends previous research on play in several novel ways. The method of measuring variability within object toy play has yet to be reported in this way. It is a different approach or perspective of diversity compared to previous studies used more global measures of variability (e.g., number of different topographies during the session;

Frey & Kaiser, 2011; Lalli, Zanolli & Wohn, 1994). It is then assumed that an increase in topographies equates to increased variability. The definition for varied play in the current study is more temporally based in that it requires inspection of the play behaviors before and after the action in question and therefore a more detailed perspective of variability in play.

Another contribution of this study is the use of lag schedules to explore creative endeavors with children with autism. Lag schedules have extensive support for increasing variability in basic research with pigeons and other nonhuman subjects (Neuringer, 2004). In recent years, research on lag schedules in more applied ways has begun to emerge. Lag schedules have been used with individuals with disabilities to increase simple and discrete play behaviors such as responding to social questions (Lee, McComas & Jawor, 2002) and selection of preferred materials (Lee & Sturmey, 2006). The current study was translational in that it explored how knowledge from the basic research arena might be used in applied settings and situations. In doing so, there is more than enough room for discovering which variables are salient to influencing intervention effects. Additionally, previous applied studies on lag schedules have investigated lag schedules as the lone independent variable. This study aimed to use lag schedules in conjunction with an established intervention. Given the results, this combination of interventions, however, may have proven to interact more than originally thought or expected.

This study also extends the methodology used for increasing play using video modeling in two ways. From the perspective of experimental rigor, previous video modeling studies conducted baseline phases that failed to include a comparable form of video technology to that in subsequent video modeling phases. Although it seems like a small detail, experimentally it cannot be ruled out that the introduction of the video technology itself (i.e., the act of watching a video on an iPad or television) rather than the contents of the videos were responsible for any resulting effects. Implementing this step attempted to minimize threats to internal validity and increase the confidence in the video model as the cause of increased play behavior. Additionally, previous video modeling studies described selecting participants who were reported by caregivers to have general imitation skills. However, researchers did not actively confirm the participants' abilities to demonstrate imitation of a video as part of the selection criterion. As an aside, there were several potential participants who were excluded from this study because of this pre-assessment step. They did not demonstrate understanding of imitating a video or attempted any behaviors related to the content of the video. These children would therefore need to be taught this initial skill prior to participating in such a video model study. The pre-assessment step helped ensure participants appropriate for the purposes of this study and could explain why some of the participants involved in previous literature required additional supports aside from the video model intervention (Hine & Wolery, 2006; Kleeberger & Mirenda, 2010; Maione & Mirenda, 2006)

Finally, only a handful of video modeling studies reviewed in chapter 2 reported social validity measures (Hine & Wolery, 2006; Kroeger, Schultz & Newsom, 2007; Nikopoulos & Keenan, 2007; Reagon, Higbee & Endicott, 2006; Sancho, Sidener, Reeve & Sidener, 2010). While these social validity measures were not assessed for true reliability or validity, they represent the perspectives and opinions of clinicians and parents, both important stakeholders of the children. Without positive perceptions of the intervention components or outcomes, an intervention is unlikely to be supported and therefore implemented, in which case this intervention research would be somewhat less relevant from an applied perspective. The positive feedback from both clinicians and parents, however, suggests that this would not be the case and that continued improvements to the intervention effectiveness are worth pursuing.

Limitations

There are several limitations in the current study. First and most obvious is that there was not a demonstration of an intervention effect by adding a lag 2 schedule of reinforcement to the video model intervention. One explanation aside from previous discussion is that there were potential sequence effects in play. Given that there were multiple exposures to the video model intervention prior to the introduction of the lag schedule it is possible this interfered with the potential effectiveness of the lag schedule. For instance, in the first few video model sessions for Tony, Steve, Clint, and Natalia, the sequence of play actions was still new and the children often interspersed unscripted play with the scripted play. Prior to concretization of the video model sequence of play could be an ideal window of opportunity to encourage unscripted play behaviors. Future research should test the effects of introducing video modeling and lag schedules simultaneously.

Second, the operationalization of what constituted play behaviors inevitably ignored some behaviors that *could* be considered play by others. For example, removing the lion from the car and putting him on the ground was not included as a play action, but could perhaps be argued as the lion "leaving the car". There may be different interpretations to observed play behaviors and but only the person doing the playing may know with certainty the intended meaning of the action (Barton & Wolery, 2008), making play notoriously problematic to reliably measure. If the child makes the lion face down into the carpet and says, "yum, the lion likes to eat grass" two observers would likely interpret this as a pretend play action in which the lion is eating imaginary grass. However, if a child lays the lion face down into the carpet repeatedly but does not say anything, the two observers may interpret the functionality of this action differently. The general limitation that play is a complex and dynamic behavior and can be interpreted a number of ways by different people was minimized by the development of an individualized list of play topographies for each child and the operationalization of each action in a very specific format.

The current study did not account for reinforcer consumption of the food reinforcers. The addition of edible reinforcement may have slowed the rate of play behaviors as the children often stopped to consume the food. Food also may not be a suitable reinforcer for play as the children at times performed several varied play actions within a few seconds and therefore received several pieces of food within a few seconds. This could potentially affect the variability measurement in negative ways, if not properly accounted for. Other types of reinforcers such as specific social praise should also be considered.

Finally, the conclusions of this study might be enhanced if the results were compared to the play of a comparison group of similarly aged typically developing children. Although understanding whether these levels of varied actions and unscripted play are comparable or similar to other children was admittedly not the purpose of the study, it would be important to confirm if the expectations of play are realistic or appropriate.

Future research

The results of this study produced more questions than it answered. In highlighting what little is known, such questions should optimistically be viewed as more inspirations for future studies.

First and foremost, the methodologies of using a lag schedule component with video modeling need to be modified so that the effects on play skills can be more accurately assessed. The children who participated in this project demonstrated some varied play behaviors that met the lag 2 contingencies during baseline. There may be greater intervention effects with children who demonstrate fewer unscripted play actions or have more non-varied actions in baseline in which case, careful selection of participants is required. Additionally, modifications to make the lag schedule requirements more salient or discriminable should be explored. For example, a video model could be developed introducing new play behaviors, but in a less varied manner such that the child does not meet the lag requirement for following the sequence of scripted play. Additionally, the child could be taught the lag schedule requirements or to "try something different" prior to the play session. Finally, more specific praise could be used (e.g., “good job doing something different!”) instead of the general praise used in the current study (e.g., “good playing!”).

A second area of future research could examine the effects of video modeling with a lag schedule on other dependent variables. Although the video model included verbalizations in the video model, verbalizations were not measured or reinforced in this study. Language skills are not only an important component of play but often play is the medium in which language skills are targeted for children with autism. Additionally, novel toy play or other specific types of toy play could also be targeted (e.g., pretend play action, sequences of play actions, reciprocal play with peers).

Given the success of video modeling, finding ways to increase the efficacy warrants examination of whether multiple video model examples could be used in a short period of time to expand a child’s play repertoire. If so, when should a new video be introduced? Is it better to introduce it when the previous video is not yet mastered or is it better to have more freedom and flexibility programmed within the acquisition phase of learning? In other words, could the use of multiple videos provide enough increases in play repertoires to encourage generative play behavior (such that the child is creating new storyline sequences using scripted play topographies)?

Finally, the general use of and resulting effects of lag schedules (or other reinforcement schedules) to increase creativity of individuals with disabilities is an area of research that continues to be deficient. Because there are differing views on whether the addition of contingent rewards increases or actually interferes with creativity in individuals *without* disabilities (Eisenberger, Armeli & Pretz, 1998), this area would be fascinating to investigate with a different population.

Appendix A

List of Play Behaviors

Numeric code	Play action	Place on toy base	Topography or behavior	Notes
		Character placements on toy		
1	in swing	swing	placement	
2	In treetop #1 or treetop #2	tree tops	placement	
3	on ice	top surface near handle (white)	placement	
4	on nest button	grey button	placement	
5	character (or car) on slide	Platform/top of slide	placement	
6	on tilting leaf	green leaf that tilts	placement	
7	on green flap	on green flap that closes	placement	
8	on red button	red button at bottom of toy	placement	
9	hippos mouth	on top of hippos head or on green lily button	placement	
10	on peek-a-boo tree	tree with window	placement	
11	under slide in green"pasture"	green "pasture" under slide	placement	
12	on rock under slide	rock ledge under slide	placement	
13	pasture under	brown area under tree	placement	

Numeric code	Play action	Place on toy base	Topography or behavior	Notes
	treetops			
14	on top of another animal	character on top of another character's head	placement	
15	in car	character placed in front or back of car	placement	only counting in car (not out)
16	on red stage	placed on red square at bottom	placement	
40	character under slide area (back)	character placed under the slide on the back of the toy		
44	character at bottom of slide		placement	
		Character actions		
18	swinging	swing	swing moved (pushed, turned)	
19	jumping		character moved up and down different heights, contacting a surface multiple times (+2) between changes in direction (up and down).	
21	feeding another character	anywhere	tap characters together facing each other	w/ or w/o verbalizations; includes 2 characters

Numeric code	Play action	Place on toy base	Topography or behavior	Notes
22	character talking	ground	jumping w/ vocalization	
24	sliding		character placed down slide or moved along curve of slide upward or downward by hand	action is designated by one length of slide or considered two actions by 3-s break when moved up and down consecutively by hand
26	gate open/close		open/close; character moves through before or after	(not counting initial gate open)
27	spin treetop	Taller treetop (#2)	turn treetop at least 3 clicks with character in it	
28	character fall off leaf	green leaf	character falls off (turn the leaf, character pushed off leaf or placed on tilted leaf so it falls automatically)	
29	hide character on green flap (close flap)	green flap	open/close flap while character is on flap	(not counting initial opening of flap)
30	character through gate area (back to front or front to back)	area under tree	may or may not open/close gate, but character enters on one side and moves to other	

Numeric code	Play action	Place on toy base	Topography or behavior	Notes
			side	
31	drive car	table or ground	move car forward or backward, with or without character at least 3-s or 6-in	
35	character jumping across base		character (jumps) across 2+ places, not staying for more than a second in one spot	
36	chasing		character “walks/runs” behind another character	
38	feeding the hippo		character down slide as hippo mouth is pushed open or attempting to place character in hippo mouth	
39	all characters "wake up"		all characters moved upright or brought down off of zoo with relevant verbalization ("time to get up or wake up")	

Numeric code	Play action	Place on toy base	Topography or behavior	Notes
42-T	turn characters around		turning around character at least 180 degrees	
43-T,C	"throws" character	anywhere	movement that makes character fall out/off of something (e.g., dumping out of car, shaking character out of car, dumping out of swing)	
49-T	making hippo mouth open (green button)		character on button so that hippo mouth opens once or can be repeatedly; designated as two actions when separated by 3-s break	
	down slide if misses when falling off of leaf	slide		Repair action from script (#50)
51-C	animal "pushes" another character		places animal against another toy w/ contextual verbalization	
51-S	"dump" character out of swing	swing	pulls swing up so character falls out	
52-S, T	"fall" off top of toy	toy base	deliberately pushes or	may or may not

Numeric code	Play action	Place on toy base	Topography or behavior	Notes
			hits character off of top of toy	comment about falling or make a falling noise (e.g., "ahhhh")
53-S	"flying"	move character through air	deliberately (slower than just transporting) moving character/car through air for about 2-s;	may or may not comment about flying

Appendix B

Video Model Script

Video Model Script					
#	**numerical code**	**agent**	**Place on toy**	**child's actions**	**verbalization**
1	2	gorilla	taller treetop (#2)	(placement)	
2	27	gorilla	taller treetop (#2)	spin treetop	"wheeee"
3	22	zk	ground	character talking	"come down, its lunch time"
4	6	gorilla	tilting leaf	(placement)	"ok"
5	28	gorilla	tilting leaf	tilt leaf so character falls onto slide	"ahhh"
6		gorilla	slide	"repair action": put down slide	
7	21	gorilla and zk	ground	tap characters (while facing each other) together	<eating sound>/yum yum
8	12	gorilla	on rock under slide	character under slide	"time for a nap"/<snoring>
9	22	lion	ground	character talking	"I'm sleepy too"
10	7	lion	green flap	(placement)	
11	29	lion	green flap	close flap	"good night"
12	22	zk	ground	character talking (jumping w/ vocal)	"wake up everyone!"

Appendix C

Sample IOA Data Sheet

Participant: ______ Video name: video 3 Coded date:

Time: 0:38-5:38 Coder initials:

Number	Time	Character(s)	Place(s) on toy	Action	A or D	code	Varied?	S or U
1	0:39	gorilla	slide	sliding (down)		24	0	u
2	0:41	child’s finger	lily button	press button to open hippo mouth		49	0	u
3	0:47	zk	taller tree (#2)	(placement)		2		u
4	0:51	zk	swing	(placement)		1		u
5	0:57	zk	peek a boo tree	(placement)		10		u
6	1:08	zk	tilting leaf	(placement)		6		u
7	1:17	zk	flap	(placement)		7		u
8	1:19	zk	lily button	press button to open hippo's mouth		49		u
9	1:22	gorilla	lily button/slide	character down slide while hippo mouth open		38		u
10	1:30	child's finger	lily button	pressing button to open hippo's mouth		49		(u)

11	1:33	gorilla	lily button/slide	character down slide while hippo mouth open		38		(u)
12	1:47	child's finger	lily button	pressing button to open hippo's mouth		49		(u)
13	1:54	gorilla	lily button/slide	character down slide while hippo mouth open		38		(u)
14	2:00	lion	slide	sliding		24		u
15	2:05	lion	slide	sliding		24		(u)
16	2:17	lion/gorilla	treetops	(placement)		2		u
17	2:33	lion/gorilla	treetops	turning		42		u
18	3:09	gorilla	slide	sliding		24		(u)
19	3:25	gorilla	slide	sliding		24		(u)
20	3:38	gorilla	slide	sliding		24		(u)
21	3:51	gorilla	slide	sliding		24		(u)
22	4:12	gorilla	slide	sliding		24		(u)
23	4:23	gorilla	slide	sliding		24		(u)
24	4:36	gorilla	under tree	through gated area (back to front)		30		u
25	4:43	gorilla	under tree	through gated area (front to back)		30		(u)
26	4:45	gorilla	under tree	close gate		26		u

27	4:49	gorilla	slide	sliding		24		(u)
28	4:52	gorilla	slide	sliding		24		(u)
29	4:57	gorilla	slide	sliding		24		(u)
30	5:02	gorilla	slide	sliding		24		(u)
31	5:09	gorilla	slide	sliding		24		(u)
32	5:16	gorilla	slide	sliding		24		(u)
33	5:21	gorilla	slide	sliding		24		(u)
34	5:33	gorilla	slide	sliding		24		(u)

v =	s =
	u =

Appendix D

Fidelity Data Sheet

Child participant: Video name:
Rater: Date of rating:

Fidelity checklist

BASELINE PHASE

RESEARCHER BEHAVIORS	CORRECT	INCORRECT	N/A
1. The researcher will show the child a 30-40 s video (unrelated to the toys) on the iPad (viewed 1-2 times).			
2. Child is seated in front of play materials (but not given access to characters) until after the video.			
3. If the participant stops watching the video for more than 3 seconds, the researcher redirected him or her to the video (pointing prompt and instruction, “watch the video”).			
4. After viewing the video, the researcher gives instructions to play with the toys (“Here are some toys you can play with.”).			
5. No other prompts/instructions regarding *how to play* are given (occasional reassurances about how long or what activity is next are okay).			
6. If child attempts to leave the area prior to the end of 5 minutes, the child is redirected back to the toys.			
7. The child is prompted to “play with the toys” after approximately 20-s of failing to play or attend to the toy.			
TOTAL			

VIDEO MODELING PHASE

RESEARCHER BEHAVIORS	CORRECT	INCORRECT	N/A
1. The researcher will show the child the video model video on the iPad (viewed 1-2 times).			
2. Child is seated in front of play materials but not given access to characters until after the video.			

3. If the participant stops watching the video for more than 3 seconds, the researcher redirected him or her to the video (pointing prompt and instruction, “watch the video”).			
4. After viewing the video, the researcher gives instructions to play with the toys (“Here are the toys you can play with. You can play like the video.”).			
5. No other prompts/instructions regarding *how to play* are given (occasional reassurances about how long or what activity is next are okay).			
6. If child attempts to leave the area prior to the end of the 5 minutes, the child is redirected back to the toys.			
7. The child is prompted to “play with the toys” after approximately 20-s of failing to play or attend to the toy.			
TOTAL			

VIDEO MODELING + LAG PHASE

RESEARCHER BEHAVIORS	CORRECT	INCORRECT	N/A
1. The researcher will show the child the video model video on the iPad (viewed 1-2 times).			
2. Child is seated in front of play materials but not given access to characters until after the video.			
3. If the participant stops watching the video for more than 3 seconds, the researcher redirected him or her to the video (pointing prompt and instruction, “watch the video”).			
4. Immediately after viewing the video, the child is given the same toy from the video and instructed “Here are the toys you can play with. You can play like the video however you want”.			
5. No other prompts/instructions regarding *how to play* are given (occasional reassurances about how long or what activity is next are okay).			

6. The researcher provides praise and/or preferred edible after approximately every play action that differs from the previous two play actions. (This must occur for at least 80% of possible reinforcement opportunities to be counted correct.)			
7. If the child attempts to leave the area prior to the end of the 5 minutes, the child is redirected back to the toys.			
8. The child is prompted to “play with the toys” after approximately 20-s of failing to play or attend to the toy.			
TOTAL			

Appendix E

Social Validity: Intervention Implementation

Therapist Questionnaire

Number of years experience working with children with autism:

<u>Video modeling</u> (VM)

Please watch the video model example video prior to answering the following questions in this section.

1. After watching an example of the VM intervention for play being conducted, I believe I COULD carry out this intervention with a child with autism.

1----------2----------3----------4----------5
strongly disagree strongly agree

2. Learning to conduct a VM intervention to teach play skills would take LOTS of training.

1----------2----------3----------4----------5
strongly disagree strongly agree

3. A VM intervention is an APPROPRIATE intervention for teaching play skills to young children with autism.

1----------2----------3----------4----------5
strongly disagree strongly agree

4. A VM intervention is APPROPRIATE for use in a home or classroom.

1----------2----------3----------4----------5
strongly disagree strongly agree

<u>Video model and lag schedule of reinforcement</u> (VM + lag 2)

5. A lag schedule is a reinforcement schedule used to increase *variability* of behavior by reinforcing only the responses that are different from previous responses.

A lag 2 schedule of reinforcement requires that the teacher deliver reinforcement for every response that is different from the *two* prior responses (see the chart below). The first two actions are not reinforced because there are not any previous actions to compare them to. Action 3 would not be reinforced because it is the same as action 1 of the "two prior responses window". Since action 4 *differs* from actions 2 and 3 and action 5 from actions 3 and 4, these behaviors would be reinforced.

Action 1	Action 2	Action 3	Action 4	Action 5
Lion **down slide**	Lion on **swing**	Lion **down slide**	Lion on **tree**	Lion on **swing**
--	--	--	+	+

After hearing a description of the lag 2 procedures, I believe this reinforcement schedule would be very DIFFICULT to carry out with a child with autism during play.

1----------2----------3----------4----------5
strongly disagree strongly agree

6. (Please watch the example VM + lag 2 video prior to answering this question.) After watching the video of the combination intervention (VM + lag 2) being conducted, I believe I COULD correctly carry out this intervention with a child with autism.

1----------2----------3----------4----------5
strongly disagree strongly agree

7. Learning to use the combination intervention (VM + lag 2) would take INTENSIVE training.

1----------2----------3----------4----------5
strongly disagree strongly agree

8. I think the combination intervention (VM + lag 2) is APPROPRIATE for teaching play skills to young children with autism.

1----------2----------3----------4----------5
strongly disagree strongly agree

9. I think the combination intervention (VM + lag 2) is APPROPRIATE for use in the home or classroom.

1----------2----------3----------4----------5
strongly disagree strongly agree

Appendix F

Social Validity: Play Outcomes

Parent Questionnaire

Relation to child: ________________

- There are no right/wrong answers. Please circle the best option to complete the sentence.

1. I believe _______ depicts my child's play BEFORE the play intervention.

   a) video 1
   b) video 2
   c) not sure

2. My child's play in ________ looks to be the most appropriate for his/her age.

   a) video 1
   b) video 2
   c) not sure

3. My child's play in _______ demonstrates MORE variety of play actions.

   a) video 1
   b) video 2
   c) not sure

4. My child's play in _______ appears to follow a story line.

   a) video 1
   b) video 2
   c) not sure

5. My child's play in ________ looks the MOST SIMILAR to how other children without a disability diagnosis play.

   a) video 1
   b) video 2
   c) not sure

6. My child's play looks MOST improved in ________.

   a) video 1
   b) video 2
   c) not sure

7. My child appears to be LESS engaged in playing with the toy in ____________.

a) video 1
b) video 2
c) not sure

8. My child's play in video 1 looks contrived or unnatural.

1----------2----------3----------4----------5
strongly disagree strongly agree

9. I believe my child benefited from participating in this study.

1----------2----------3----------4----------5
strongly disagree strongly agree

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*denotes studies included in the literature review

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Vita

Christina Lin Fragale was born in Austin, Texas and is the daughter of Jiang-Jen and Zenaida Lin. Upon graduation from Stephen F. Austin High School in Sugar Land, Texas, she entered the University of Texas at Austin in 1998, where she earned a Bachelor of Science in Microbiology in 2003. During subsequent years, she was employed as a teacher in a school for children with learning differences, where she worked with preschool and school aged children with autism and other disabilities. During this time, she also earned a Master of Education in Special Education from the University of Texas at Austin in 2008. She continued her graduate studies, entering the doctoral program in special education in the fall of 2008. She was the 2010 winner of the Berkshire Association for Behavior Analysis and Therapy (BABAT) student paper award for original research in recognition of the paper, "The Influence of Motivating Operations on Generalization Probes of Mands". Additionally, she has co-authored several book chapters, peer-reviewed articles, and presented at national conferences in the field of autism spectrum disorders and developmental disabilities.

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